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Convertible Farm Buildings

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MEMBER A.S.A.E. FELLOW A.S.A.E.

"READY convertibility of buildings from one service to another; this is an essential part of the general scheme of prefabrication"[2]* is one of the points proposed by Professor Leslie E. Hazen in his letter to members of the Committee on Postwar Objectives of the American Society of Agricultural Engineers. Research on and development of the design of convertible farm buildings have been in progress at the Iowa Agricultural Experiment Station for several years. A specific project on the adaptation of buildings and equipment to meet changes in farm operation was inaugurated about two years ago and equipment studies are now being pursued on full-scale working models.

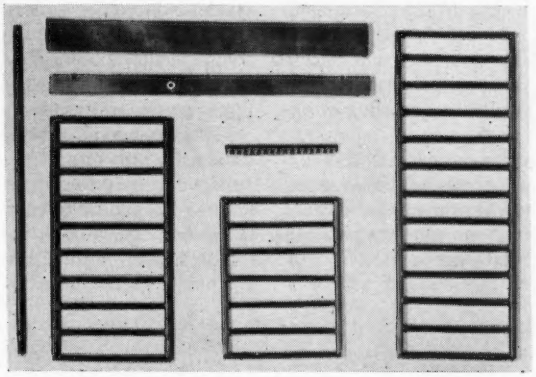

Fig. 1 The seven basic items of barn equipment used in the Iowa studies: 3x8-ft, 3x6-ft and 3x4-ft panels; 2x6-inx8-ft and 2x10-inx8-ft planks; 1⅜-in O.D.x8-ft pipe, and 1¾x1¾-inx2-ft 8-in light steel angle

Most farm buildings are designed and equipped to serve a particular function. The term "general purpose" as applied to farm buildings, usually implies the housing of a number of enterprises under one roof with definite space allocations and fixed equipment for each enterprise rather than adaptabilty of entire enclosures to numerous uses. The functional design of individual buildings by accurate analysis of the biological, structural and mechanical factors involved can produce buildings exceptionally well suited for an immediate purpose. However, functional requirements of buildings are not static and convertibility of buildings regardless of construction methods employed, is a primary concern of the farm manager as well as the building designer or fabricator.

Relatively few farms are so ideally suited to a specific production program that the requirements for buildings are independent of the personal tastes and abilities of the operator. U. S. Census figures for 1940 show that the average tenure period for all farm operators is less than 12 years. The average tenure period on tenant-operated farms, which comprise 38.7 per cent of the total, is only five years. In comparison, the life expectancy of the major farm building types is 40 years or more depending upon the construction material employed. The average building must render service for 4 operators with some change in types of production, management methods, and housing requirements accompanying each change of operator. The worth of existing buildings to the new operator is influenced by the ease with which they may be adapted to his needs. Inflexibility of buildings reduces both their sale value and their appeal to the best potential tenants.

Major alterations required to accommodate new operators or new operations constitute a sizable item in total farm building construction costs. This is, however, of less concern than the penalties which derive from the failure of buildings to meet the changing requirements of housing going enterprises. Until the premium or penalties for providing or failing to provide optimum housing conditions in farm buildings can be established, the value of buildings must be determined largely by their continued effectiveness as labor-saving devices. To attain and retain parity with industry the farmer must make and continue to make comparable improvements in labor efficiency. The physical volume of industrial production per worker has increased since 1900 at the compound rate of about 1¾ per cent per year[3]. If the life expectancy of buildings is placed at 40 to 60 years, the farmer must ultimately attain within those buildings a labor efficiency two to three times the initial rate. To meet these requirements, buildings adapted to continuous alteration rather than periodic remodeling are essential.

Initial studies on the convertibility of buildings were made on existing structures. In the spring

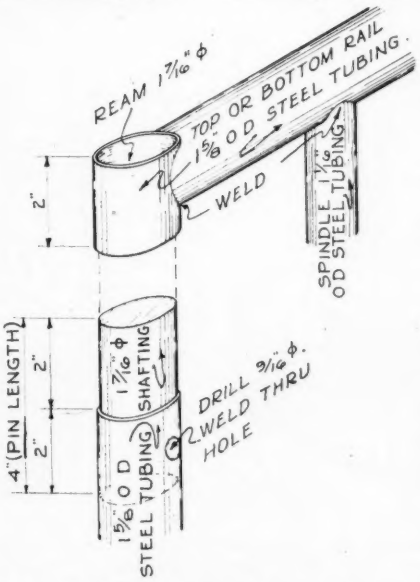

Fig. 2 The built-in hinge simplifies the dimensioning of panels

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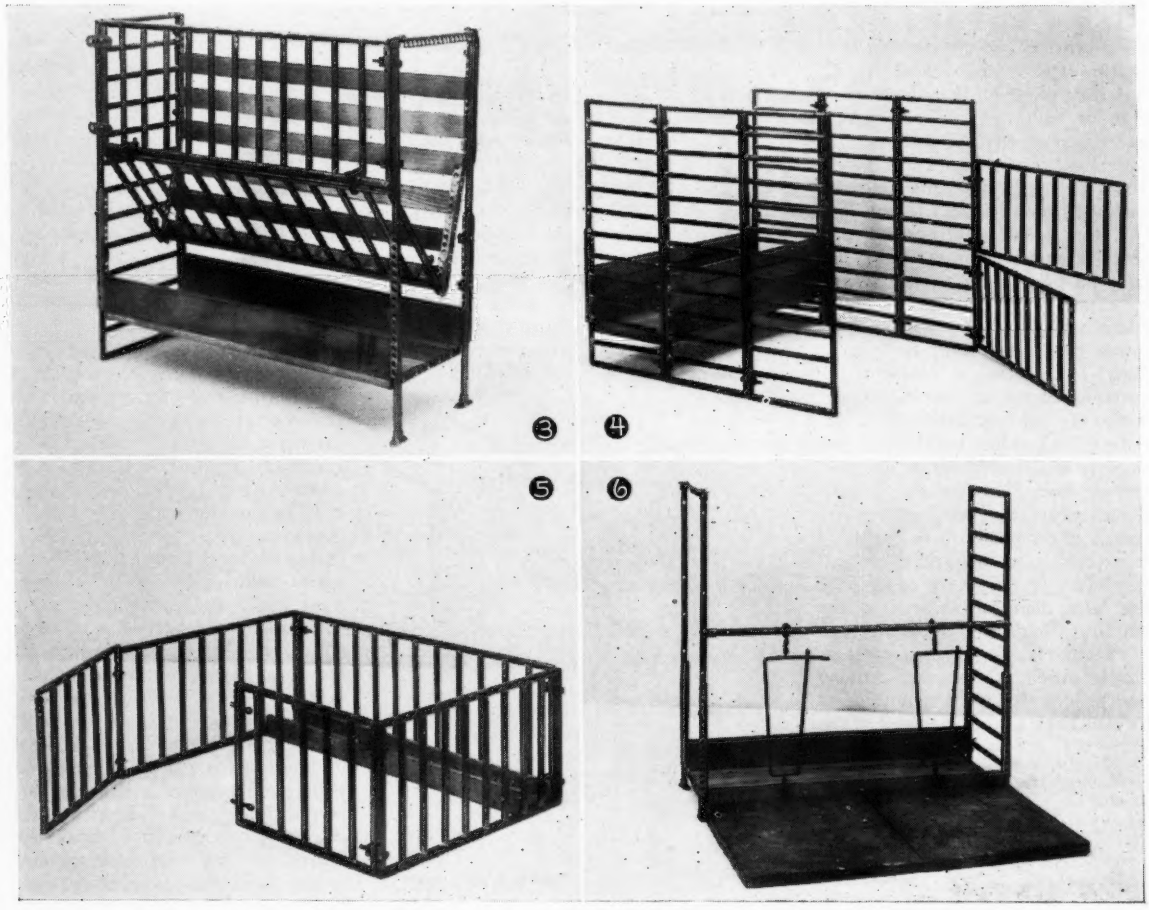
*Superscript numbers refer to appended references.

and summer of 1944 about two weeks were spent with the farm managers in making an investigation of the buildings on about 25 central Iowa farms which had recently been placed under the control of the Farmers' National Company. Some repair and remodeling of buildings on all of these farms were contemplated. Many of the problems were settled by consultation on the spot, but it was considered advisable to make detailed studies of 18 buildings, including 10 general-purpose barns, located on 12 separate farms. No highly specialized operations were practiced on any of these farms and the needs were for general-purpose structures in all cases. During the process of studying data obtained on the original buildings and preparing drawings and recommendations for remodeling, special note was made of features which caused particular difficulty in obtaining workable arrangements.

Six of the ten barns mentioned were over 40 ft wide. Mow storage capacity was in excess of present requirements in all cases, even after the central hay-to-the-ground feature was eliminated to gain some ventilation and temperature control. To make effective use of the space in the center of these barns, cross alleys or alleys in the shape of a U or T would be required. Excessive length of chore routes necessarily results from such alley arrangement. Poultry houses only 12 to 14 ft in width were rather drastically overhauled and the widths increased to about 20 ft. One permanent farrowing house inspected was 34 ft wide with a 10-ft central alley. It was recommended that this building be converted into a beef-feeding barn. It was concluded that deviations from the rather standardized widths for buildings of particular types greatly reduce their adaptability.

The design and location of interior post and girder systems were other serious obstacles in remodeling. In some cases it was necessary to revise the roof and mow supports completely to obtain a desirable arrangement. Small girders which required a close spacing of posts were replaced with larger members.

The conventional scheme of dividing barns of nearly standard width into three equal structural bays can be recommended only because it results in the use of minimum sizes of floor joists or roof framing. Posts come within the pen areas regardless of the direction in which animals are faced. In conventional barns using a face-out arrangement, the posts can be located adjacent to the central driveway



COMBINATION OF STANDARD BARN-EQUIPMENT ITEMS

Fig. 3 8-ft section of feed bunker and manger. Pipe rails are used as vertical supports except at exposed ends of bunkers • Fig. 4 The 8-ft horse stall uses exactly the same items of equipment used in an 8-ft bunker and manger. Stall is converted to a box stall or pen by addition of 3x6-ft panels used as gates. Entire manger can be raised or lowered as desired • Fig. 5 The same construction as used here for farrowing pens is used for pens for other animals. Panels may be "stacked" to form partitions 6 ft high • Fig. 6 Standard stanchions and sectional platforms would be needed to adapt the system to dairy-cow stalls.

without appreciable increase in span lengths of outside bays but with considerable improvement in plan flexibility. Placing of posts adjacent to the central feed alley in face-in barns will normally require a 2-in increase in the depth of mow floor joists. This arrangement gives almost complete freedom from posts in establishing the length or width of stalls and pens.

Difficulty with posts was also experienced in the remodeling of small buildings. This appears to be a needless obstacle since no measurable initial cost advantage results from use of posts and girders in lieu of clear-span roof construction on one-story buildings less than 24 ft wide.

Pen and stall partitions were frequently incorporated into the structural scheme in such a way that removal of the partitions involved removal of structural supports. This would also appear to effect only the most minor initial economies and contribute unduly to the difficulty of remodeling.

A search for remodeling obstructions in the present plan offerings of the Midwest Farm Building Plan Service and of a number of industrial organizations reveals that these same features are present but with numerous additions. Recent structural improvements in the use of wood, masonry, concrete, steel, and other materials have the rather common feature of eliminating hinged joints or planes of weakness wherever possible. Larger unit sizes of facing materials with more rigid attachments are also used. Most of the larger buildings inspected on the survey previously mentioned used some form of post and girt construction in outside walls which caused little difficulty in the relocation of wall openings. Load-bearing walls are predominantly shown in the present plan offerings. Far greater use is now made of concrete and steel in floors, mangers, stanchions, partitions, etc. Foundation bulkheads below frame walls often extend only a few inches above the ground level and consequently give little protection to either sills or siding. They will be exceedingly troublesome if doors must be relocated.

MOST STRUCTURAL IMPROVEMENTS CONTRIBUTE TO GREAT STABILITY OF BUILDINGS

Most of the structural improvements contribute to greater stability of buildings and equipment, to reduced maintenance costs, and to a longer life expectancy for the structures. However, unless special provision is made for greater facility in altering these buildings, their structural life expectancy is completely out of line with the life expectancy of the enterprises which they are suitable for housing and the added rigidity of buildings and equipment may actually contribute to their early obsolescence.

The multiplicity of equipment types and of basic dimensions used for buildings which serve the same purpose is confusing to the farm owner or manager in making a selection of the proper building plan to perform a necessary function and reduces building flexibility. The standardization of building dimensions could make possible the standardization of component parts of both buildings and equipment with a resulting interchangeability of parts and mass production economies in their manufacture. A listing of the barn widths in the plan offerings previously mentioned shows that widths of 32, 34, and 36 ft are predominant, with 36 ft the most popular choice. Beef-feeding barns with central feed storage are considerably wider but many plans are shown of 36-ft feeding barns which seem to offer equal advantages. Likewise, the smaller service buildings including stationary hog houses, poultry houses, two-car garages, farm shops, machine sheds, cattle sheds, and sheep sheds are shown primarily in widths ranging from 18 to 26 ft with the average for the group, as well as most individual types, approximately 22 ft. Of this group of buildings only stationary hog houses used as farrowing houses have fixed pens. The only items which have lengths greater than 22 ft likely to be housed in these structures are threshing machines and some items of horse-drawn equipment with the tongue fully extended. Standardization of the widths of barns and the smaller service buildings at 36 and 22 ft, respectively, would not appear to impair their general function.

Man is the tallest animal unit on the completely mechanized farm. Consequently, the ceiling height of buildings other than storage structures is largely a function of the height of the operator. A clear height of 6 ft 6 in to 7 ft from floor to the underside of girders provides ample clearance for the average man to work and allows for some accumulation of litter on floors. If a maximum girder depth of 12 in is added, a minimum ceiling height of 7 ft 6 in to 8 ft is established. Since practically all structural materials are obtainable in even or fractional lengths of 8 ft, standardization of this ceiling height in all buildings other than storage structures seems practical. If girders are placed outside the pen areas as previously suggested, this height is adequate to accommodate horses and some makes of manure loaders. With both widths and heights thus established, only two basic cross sections are needed to meet the requirements for the majority of buildings of these types.

THE "UNIT-SPACE" METHOD OF PLANNING GENERAL-PURPOSE FARM BARNS

The smaller service buildings contain little fixed equipment and exact lengths are not an important consideration in determining their adaptability. Exact lengths are important in barn planning or barn alteration, and with standard heights and widths established, it remains only to apply some standard increment of length to reduce the entire structural planning and construction to a modular system. Carter[1] introduced the "unit-space" method of planning general-purpose barns based on a standard increment of barn length equal to 40 in, with one unit being equal to the width of a cow stall and three units, or 10 ft, being used as a standard width for horse stalls and box stalls. Certain factors now indicate that an increment of 4 ft might offer comparable advantages from the planning standpoint and would be more adaptable to both prefabrication and job-built construction.

Conventional lengthwise dimensions used in barn design, with the comparable dimensions resulting from the adoption of 4-ft "modules" of barn length, are listed as follows:

Unit	Lengthwise dimensions	Standardized length	Number of 4-ft modules
Cow stall	3 ft 4 in to 4 ft	4 ft	1
Double horse stall	8 ft to 10 ft	8 ft	2
Box stall	8 ft to 12 ft	8 or 12 ft	2 or 3
Maternity pen	8 ft to 12 ft	8 or 12 ft	2 or 3
Cross alley	3 ft to 4 ft	4 ft	1
Stairway	3 ft to 4 ft	4 ft	1
Feed storage	5 ft to 12 ft	4, 8, or 12 ft	1, 2, or 3

Lumber is usually sold in standard length increments of 2 ft and 16 or 24 in are standard spacings for framing members. Building materials furnished in panels are usually furnished in 16, 24, or 48-in widths with 8 ft the most commonly stocked length. Likewise, 8 in, 12 in, and 16 in are the standard lengths of masonry units. The 4-ft unit is adaptable to almost every type of construction material.

The 4-ft increment of building length is derived from the same increment in length of individual items of equipment. Maximum height of 8 ft for the equipment items is also established by the ceiling height. This convenient 1-to-2 relationship of length and height of equipment suggests

the possibility of securing flexibility in the equipment itself by use of panels placed in either a vertical or horizontal position. If a convenient increment of width be established for the various equipment items, the modular planning basis is complete for both structure and equipment. Component parts of the equipment might be standardized and interchanged at will.

A study of the standard crosswise dimensions used in barn planning, listed as follows, shows that a 3-ft increment is commonly adaptable to equipment widths:

Unit	Crosswise dimensions	Standardized width	Number of 3-ft modules
Horse stall partition	9 ft	9 ft	3
Box stall, horses	12 ft (min.)	12 or 15 ft	4 or 5
Cow stall, (overall)	9 to 10 ft	9 ft	3
platform and gutter	6 to 7 ft	6 ft	2
curb and manger	3 ft	3 ft	1
Cow pens or maternity pens	9 ft (min.)	9, 12, or 15 ft	3, 4, or 5

It is thus shown that the space enclosures for the common types of stalls and pens are multiples of rectangular

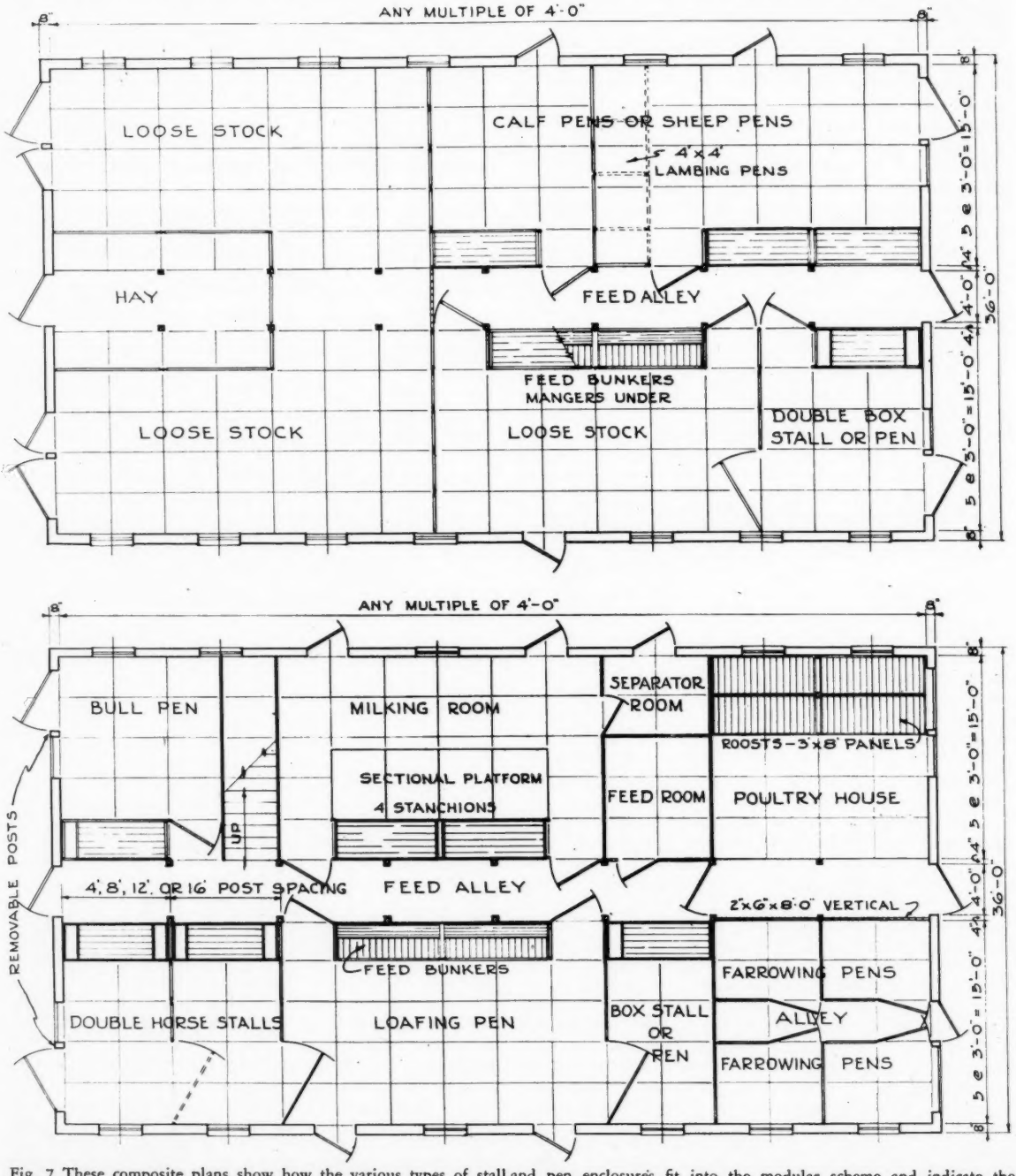


Fig. 7 These composite plans show how the various types of stall and pen enclosures fit into the modular scheme and indicate the equipment units required to complete the enclosures. Note the almost complete independence of plan arrangement and post location

solids 3 ft by 4 ft in plan and 8 ft in height. A system of barn equipment with unit sizes adapted to fit together to enclose these standard space units with full or half-height partitions would not only lend itself to mass fabrication and sales methods but would be almost completely flexible in that an almost unlimited number of combinations could be assembled from a few basic units.

Fig. 1 illustrates the basic units of equipment which we are now using in our study. The photographs shown were made from the original 1/8-scale working models. A description of the full-scale units represented follows:

PANELS:

Construction:	1⅝-in O. D. high-carbon steel tubing rails 1 1/16-in O. D. high-carbon steel tubing spindles. (Spindle spacing: 6 in center to center)
Size:	Nominally 3x8 ft, 3x6 ft and 3x4 ft. (Actual size reduced to accommodate panel thickness at intersections)
Method of Attachment:	½-in diameter bolts. Rails drilled to provide matching holes in all likely combinations. Panel rail holes also match floor inserts laid out on a standard grid system.
Hinges:	Built in. (See detail Fig. 2)
PIPE RAILS:	1⅝-in O. D. high-carbon steel tubing (nominal length, 8 ft).
MANGERS:	2-in x 6-in x 8-ft and 2-in x 10-in x 8-ft planks. Assembled with 1¾-in x 1¾-in x 32-in light steel angles punched to receive ½-in bolts. Plank may be tightly spaced or spread in multiples of 3 in without additional drilling.

With the exception of the built-in hinge feature the construction of the panels is identical with those now available from numerous barn equipment manufacturers. The hinge was incorporated within the panel to eliminate the complication of relocating hinge-pin centers each time the panels are recombined. The fact that metal panels could be welded or pressed together with the center line of all members falling in the same plane, thus producing panels of minimum thickness, was the important factor in selecting material for working models. The basic scheme is not limited to application of any one material.

Figs. 3 to 6 show combinations of the standard equipment items required to obtain feed bunkers and mangers, horse stalls or box stalls, farrowing pens for hogs (pens for other animals are similarly assembled), and for dairy cow stalls, respectively. Standard stanchions and sectional platforms in 4-ft units would be required to complete the dairy-cow stalls.

Fig. 7 shows composite plans for a barn 36 ft in width adapted to the modular scheme of planning previously described. Comparison of the floor plans with the typical assemblies for the various stall and pen enclosures shown in Figs. 3 to 6 will indicate the manner in which the individual items of equipment fit into the general scheme. It should be noted that no major deviation from conventional building-construction practices would be required in buildings adapted to this equipment system. Building requirements may be summarized as follows:

1 The building must have a dead level floor and ceiling with ceiling height closely approximating 8 ft

2 Interior bay areas must be divisible into rectangles nominally 3x4 ft

3 No posts or other obstructions can occur between sidewalls and fixed central alleys

4 Post spacing lengthwise of the building must be some multiple of 4 ft

5 Provision for attachment of panels to concrete floors should be made at the time of building construction

6 End-wall construction must be such as to permit rather easy relocation of doors to match possible relocation of alleys.

The possibility for mass production of the few items of equipment required should tend to make the cost of such items somewhat less than comparable items now on the market. The economy of fabrication would, however, be minimized by the need for providing greater strength in panels for variable use than would be required if panels of the same size were intended for a specific application. It is doubtful if the initial cost of constructing and equipping a building of a given size could be reduced by use of the planning method and equipment system described.

The potential advantage of such a system lies almost entirely in its adaptability to fit day-to-day changes in housing requirements. Panels are secured in place with only 4 bolts per panel. The development of quick-acting, non-corrosive items of hardware to fit the panels would reduce the time required for making plan alterations to a few minutes per stall or pen. Since all panels have built-in hinges they are in effect gates rather than fixed panels. Without removing panels, all equipment except bunkers or mangers may be swung against walls or ceiling and the floor space made clear to permit rapid mechanical cleaning or temporary use of the space for some entirely different purpose.

Reduction in the total space enclosure required for one farm should also be possible. Instead of providing housing accommodations for each of the varied operations performed throughout the year it is necessary to enclose only enough space to meet the requirements at the time of peak occupancy. For example, stationary farrowing houses for hogs are often in full use only from March until May; shelters for beef cattle on the same farm are in full use only from November until March or April. Proper management and a quick adjustment of the equipment might eliminate need for one building type or the other.

REFERENCES

1 Carter, Deane G. "The Unit Space Method of Barn Planning," AGRICULTURAL ENGINEERING, vol. 9, no. 9, pp.271-73 (1928)

2 Hazen, Leslie E. "Some Postwar Objectives for Agricultural Engineers," AGRICULTURAL ENGINEERING, vol. 26, no. 2, pp. 65-66 (1945)

3 Computed from data obtained from "Census of Manufacturers", 1939, vol. 1, p. 20, Table 3, U. S. Census, 1940.

"Economic Feasibility" of Drainage and Irrigation Projects

THE question having been raised regarding the term "economic feasibility" used in paragraph 3 of the article entitled "Drainage and Irrigation Recommendations," on page 284 of AGRICULTURAL ENGINEERING for July, 1945, Howard Matson, chairman, A.S.A.E. Soil and Water Division, has made explanation as follows:

"The term 'economic feasibility' relates directly to the cost and benefit ratio. However, the statement in the first sentence of paragraph 3 concerning national need for food production and land-use adjustment was intended to make it plain that further drainage and irrigation development should be based on economic necessity and wise land use. A great deal of land now being used for the production of cultivated crops needs to be retired to meadow, pasture, or forage uses. If sufficient food production can be obtained from the remaining acreage of cropland, there would be no need for additional irrigation or drainage development at the present time. However, if this is not the case, or if in the future an increased production of food becomes necessary, then it would be desirable to undertake additional drainage or irrigation development, or both, plans for which should be based upon economic feasibility.

Factors in the Choice of Fence Posts

By Ray Crow
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THE most economical fence post to use is that which requires the smallest annual payment to amortize the total cost of installation and maintenance, including interest, over a given period of useful life. Unit price and length of useful life are two important factors in this connection, but there are others that also must be considered to determine the type that is cheapest in the long run. The principal factors pertaining to the relative economy of five types of more or less durable fence posts are considered in some detail in this paper. Two or more of these types are generally available at widely varying prices in most localities throughout the country.

Table 1 (see top of next page) briefly summarizes some of the conclusions arrived at in the more detailed discussion in this paper. The items given are general averages only. Actual local figures in each case should be substituted for those in the table to determine local comparisons.

The annual payments required for amortization of estimated costs as shown in the last line of Table 1 were determined from the accompanying chart. To use this chart for determining relative economy of different types of available posts at various prices and having different lengths of service life, proceed as follows:

1 Locate the estimated length of service life of the post in question in the column at left side of the chart.

2 Project a horizontal line to the right to a point that represents the total estimated installed cost of the same post (unit price plus handling, setting and other costs) which will be on one of the curves or proportionally between two of them.

3 From this point, project a line vertically downward to the line of estimated annual amortization payments at the bottom of the chart.

4 The vertical projection that falls farthest to the left indicates the most economical post to use from among those compared and gives the annual cost including interest at 6 per cent. Higher or lower rates of interest change this figure accordingly but will not change relative values.

LOCAL AVAILABILITY OF VARIOUS TYPES OF POSTS

Steel Posts are manufactured by practically all producers of other fence materials and made available through wholesale and retail dealers in such products throughout the country. They are found in stock at or can be obtained by local hardware stores and similar establishments.

Durable Wood Posts. Formerly posts cut from one or more species of timber that would resist serious decay for ten years or more were available in or near almost any locality. At present quantity sources of such supply are limited in size and widely scattered. This condition is rapidly growing more acute. In many sections such posts are only available by transportation over considerable distances.

Locally Treated Wood Posts. The U. S. Department of Agriculture and various state agricultural extension services have issued bulletins describing methods of local treating of non-durable wood posts produced on the farm or in the community. The equipment described ranges from primitive farm installations that cost only a few dollars to community projects running to $1,000 and more. Thus the availability of this type of post is limited to those farms or communities where such plants have been established. So far this type of treatment has not attained a widespread development.

Commercially Treated Wood Posts. Commercial wood-treating plants are rather widely scattered throughout only certain sections of the country. For the most part, therefore, this type of post is generally available only at considerable cost for transportation and distribution. Normally they are stocked at lumber yards for retail sale.

Reinforced Concrete Posts. These are not available commercially except in occasional locations. When used they are generally cast locally near the job from locally available aggregates. Due to the weight, the cost of transportation for any considerable distance is high.

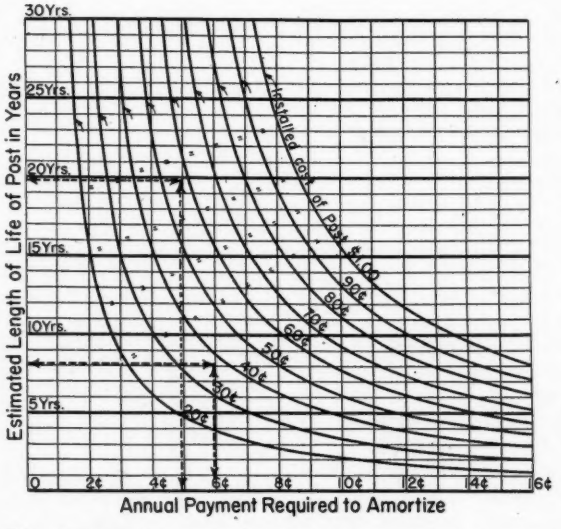
STYLES OF AVAILABLE TYPES

Steel Posts. Various manufacturers feature somewhat different shapes and styles of steel posts. Some types are self-fastening by which a punched-out tongue is bent back over the fence wire. Others are arranged for a staple to be clinched through a hole or slot, and in some cases the fence is wired to the post.

One type (the most expensive) is in the form of a galvanized pipe. Others are either angle, tee, or channel shapes with a painted finish. However, all are engineered for the purpose and thus are generally dependable.

Untreated Durable Wood Posts. Due to scarcity the present tendency is to split such posts into smaller sizes and leave more sapwood attached than was formerly considered at all advisable. Thus the better types are often not widely available for commercial purchase. Some of the most durable woods are practically off the general market.

Locally Treated Wood Posts. The most commonly used preservative is creosote mixed with coal tar or



This chart provides means for graphic determination of annual payment required to amortize the installed cost of a fence post, given the installed cost and length of usable life, with interest at 6 per cent. Example: A post that cost 37c installed and lasts 8 years requires 6c, but one that cost 58c installed requires only 5c per year, if it will last 20 years; thus is cheaper in the long run

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low-cost petroleum-derived oils applied by boiling. For good results the posts should be open-grain sap softwoods peeled and thoroughly seasoned which requires three months or more. Otherwise, satisfactory penetration will not be secured. Hardwood posts are also treated, but penetration is more difficult. Solutions of zinc and copper salts also are used as wood preservatives but are not so popular as creosote.

TABLE 1

Item	Steel Posts	Durable Wood	Locally Treated	Commercially Treated	Reinforced Concrete
Length of life, yr	20 to 25	10 to 20	10 to 20	16 to 24	30 to 40
Weight each, lb	8 to 10	16 to 35	20 to 40	20 to 40	100 to 115
Fire resistance	Full	None	Partial	Partial	Full
Set by	Driving	Holes dug	Holes dug	Holes dug	Holes dug
Installation costs—					
Unit price, cents	45 to 55	25 to 45	30 to 50	40 to 60	45 to 70
Handling, etc. "	1 to 1	2 to 3	2 to 4	2 to 4	12 to 13
Setting, "	3 to 3	10 to 12	10 to 12	10 to 12	12 to 15
Grounding, "	0 to 0	1 to 1	1 to 1	1 to 1	1 to 1
Total cost in place, c	49 to 59	38 to 61	43 to 67	53 to 77	70 to 99
Annual cost, cents	4.3 to 4.6	5.2 to 5.3	5.8 to 5.7	5.2 to 6.1	5.1 to 6.0

Commercially Treated Wood Posts. These may be round, split or sawed as to shape and of various sizes. The standard treatment most generally used is the application of 6 lb per cu ft of wood of a mixture of 80 per cent creosote and 20 per cent low-cost coal tar or petroleum derivative applied hot in metal tanks under pressure. This insures a uniform dependable job.

Reinforced Concrete Posts. They are usually cast square, tapering somewhat, and reinforced with a minimum of two, preferably four, ¼-in round or deformed reinforcing steel rods located near the corners and tied with wire. Any good aggregate can be used.

RETAIL UNIT PRICES

Steel Posts. These vary somewhat, depending on type, distance from factory and method of distribution. As indicated in Table 1, the present retail prices generally range from 45 to 55c each for the painted steel posts. Local conditions and quantities required may develop somewhat higher or lower prices.

Durable Wood Posts. These vary so widely depending on species of wood, size and uniformity of post and distance from source of supply that only suggestions can be given here. Only occasionally are quotations made of less than 30c each and this for small sizes and/or less durable wood near a source of supply. For larger posts and more durable woods at greater distances, the quoted retail prices range up to 50c and more each. Size of wood posts, as well as species of timber, have much to do with service life. Therefore, they should be carefully inspected before purchasing at any price.

Locally Treated Wood Posts. This type of post is seldom available commercially. The cost usually is made up of (1) the value of the stumpage, (2) labor cost of cutting, splitting, peeling and stacking for seasoning, (3) transportation to and from treating plant, and (4) cost of preservative and its application. A 4-in in diameter by 7-ft long post should absorb at least 3.5 lb of preservative. The actual cost of this will range from 11 to 15c or more, depending on the amount of dilution of creosote with cheap oil. In addition will be the cost of application.

If reasonable rates of pay are allowed for the latter and the other labor and transportation items mentioned, it will account for the minimum cost of 30c shown in Table 1.

Commercially Treated Wood Posts. These vary widely depending on distance from a treating plant and methods of distribution. Most plants quote prices both for treating service, only if seasoned wood posts are brought or shipped to them, and also for posts for sale direct.

In the southeastern states treating only of a 4-in diameter 7-ft long post, or one of equivalent volume, is quoted at 23¾c in lots of 250 to 1,000, other sizes and lengths in proportion. To this must be added the cost of stumpage, labor for cutting, peeling and stacking for seasoning, and transportation to and from plant anywhere up to 100 miles or more.

Reinforced Concrete Posts. These posts are seldom sold at retail on a commercial basis. However, with suitable aggregates of sand and gravel locally available they can be cast on a farm at surprisingly low cost. Prewar records were as low as 35c each. At present the minimum probably will be 45c with the average much higher. Of this, from 10 to 20c will be the cost of the reinforcing steel. To cast these posts in quantity requires a large number of forms and considerable space.

LENGTH OF USABLE LIFE OF VARIOUS TYPES OF POSTS

Steel Posts. Thousands of painted steel posts are still in use after 20 to 30 years of service with little corrosion or other evidences of failure. On occasion, highly acid soils will cause deterioration in a shorter time, but this can be prevented by coating the lower three feet of the post with neutral asphalt before driving, an inexpensive operation. Highly acid soils are not widely prevalent but this condition should be checked in any community to determine necessity of protection.

Untreated Durable Wood Posts. In reasonable sizes the average length of life of a few species used for posts where available are, according to the "Farm Fence Handbook", published by the Republic Steel Company, as follows:

Osage orange	30 yr.	Longleaf heart pine	25 yr.
Black locust	24 "	Cypress	20 "
Red cedar	20 "	White oak & post oak	10 "
Catalpa	16 "	Tamarack	10 "

However, these figures are averages only. The service life varies with the rapidity of growth, location, age and other factors pertaining to the trees from which the posts are cut.

Locally Treated Wood Posts. This will vary so widely, due to quality of preservative used and amount of penetration attained, that any definite statement is not justified. This type of treatment can do a good job if properly handled by experienced operators. The difficulty is in determining whether or not the post is effectively treated. One tendency that must be watched is to attempt the treatment of posts that are not sufficiently seasoned or that are too wet.

Commercially Treated Wood Posts. This depends on the size of the post and the amount and quality of the preservative. Many such posts are in use after 20 years and more of service. Others have, of course, failed at much less. It is thought that the length of life estimated in Table 1 is a fair average.

Reinforced Concrete Posts. A well-made reinforced concrete post can be considered practically a permanent fixture. They are sometimes carelessly handled in the casting and curing in which case they may spall and split in even a few years.

TRANSPORTING, HANDLING AND SETTING

Steel Posts. Steel line posts weigh only 8 to 10 lb each and occupy extremely small space. They can be lined and driven by one man at the rate of 10 to 15 per hour in average soils, a setting cost of 3 to 4c depending on labor rates. Thus transportation, handling and setting costs are much less than for any other type of ordinary available post.

Untreated Durable Wood Posts. Durable wood posts weigh from 16 to 35 lb or more each when well seasoned,

depending on size and species of wood. They are bulky to handle and transport and two men can set only 6 to 8 posts per hour in average soils. Usually holes are dug to full depth with a spade or posthole auger, the post set to line and the earth backtamped. They can be driven by using a heavy maul after sharpening the post and setting it in a pilot hole made with a chisel bar or pointed rod. However, but little if any saving of labor is made over digging in.

The labor cost of setting a wood post will range from 10 to 15c or more depending on price of labor and soil conditions.

Locally Treated Wood Posts. Practically the same as for untreated wood.

Commercially Treated Wood Posts. Practically the same as for untreated wood.

Reinforced Concrete Posts. These posts weigh 100 lb or more each, and thus require two men to handle. The operations of transporting, handling and setting are considerably more expensive than for any other type of posts ordinarily available.

DEPENDABILITY OF SERVICE

Steel Posts. Steel posts, if of a given type and make, are uniform in character as well as in appearance. They are engineered to serve a certain purpose and thus one is as dependable as another.

Durable Wood Posts. Wood posts are irregular in size and shape and vary widely in strength and lasting qualities from tree to tree, even in timber of the same species. In any line of fence at least a few of the posts will fail long before they are supposed to from no apparent cause.

All Treated Wood Posts. These are somewhat more dependable than untreated when a uniformly good job is done.

Reinforced Concrete Posts are entirely dependable when well made.

NEATNESS OF APPEARANCE

Steel Posts. Steel posts are uniform and clean-cut in appearance. They make a fence outstanding and add much to the sales appeal of the farm.

All Wood Posts, when reasonably uniform in size and shape, present a neat appearance, of course, but this is often not the case.

Reinforced Concrete Posts usually present an impressive appearance of neatness and strength that has a strong sales appeal.

COMPARATIVE COST OF REMOVAL AND REINSTALLATION

Steel Posts can be removed and reset for at least 10 to 15c less cost each than can any other type. This factor has no importance unless the fence is moved but a certain value is there, inasmuch as changing farming operations may dictate changing a fence location at any time.

All Wood Posts generally decay at the ground surface, leaving a neck there with the full size remaining under ground. This makes pulling difficult and in shaking the post loose it often breaks off at this neck, but would have been serviceable for several years if left in place.

Reinforced Concrete Posts. Due to the heavy weight, pulling and resetting these posts is more expensive than that for other types.

PROTECTION FROM HAZARDS

Steel Posts will not burn. A fence row fire will have little or no effect on their service life. It too hot, it may injure the galvanizing on the fence.

Steel posts automatically ground lightning charges that strike the fence. This may prevent injury to livestock at a distance from the point of striking.

Untreated Wood Posts. Some care and attention is required to prevent fire damage to wood posts by the burning of fence rows.

Many authorities recommend that when wood posts are used, the fence should be efficiently grounded at intervals of 8 to 10 rods as insurance against injury to livestock by lightning running along the fence from point of striking. This is done by attaching a heavy steel or copper wire or a steel rod or pipe firmly to the fence and sinking it to moist earth. The cost will amount to at least 1c per post.

Treated Wood Posts are more resistant to fire than untreated posts. Otherwise the same conditions apply as to untreated posts.

Reinforced Concrete Posts will not burn. Grounding of lightning same as for wood posts.

ANNUAL PAYMENTS TO AMORTIZE COST INCLUDING INTEREST

All Types. This can be estimated by reference to the chart when interest at 6 per cent is considered. Higher or lower interest rates increase or decrease annual payments proportionately but the same ratio will apply. The longer the service life of a post at a given installed cost the less the amortization cost per year.

GENERAL CONCLUSIONS

The foregoing discussion pertains to line or intermediate posts only. Corner and end posts are larger and heavier in each type and correspondingly more expensive, but the same relative conditions apply.

It would appear from the foregoing that steel posts are worthy of careful consideration when fence posts are required.

Discussion by Henry Giese

IT IS believed the following comments are pertinent to the foregoing paper by Mr. Crow: One is the use of pentachlorophenol in the farm treatment of posts which may result in considerable cheapening. In a way, however, this point is taken care of in the paper by suggesting that local figures for the several cost items be used.

The principal question I would raise, however, regarding the paper relates to the comparative performance of a steel post with a wood post. So far as we have been able to ascertain, the duty of a post has not been fixed, and will vary considerably according to whether the post is located in a division fence on a farm, in an exterior fence, or in a lot fence. There is perhaps a place for both steel and wood posts. As Mr. Crow has stated, steel posts can be both set and removed more readily than wood posts. This factor is favorable to the use of steel posts for movable fences. Farmers in our area, however, are now driving considerable quantities of small wood posts. This tends to make the cost of setting a wood post comparable to that of a steel post.

If a farmer is satisfied with what a steel post will do for him, it has the definite advantages as indicated. In the paper, entitled "Overturning Resistance of Wood Fence Posts", published in AGRICULTURAL ENGINEERING for May, 1943, it will be noted that the steel fence post failed completely under a load of approximately 125 lb. This could be increased slightly if the post were set deeper than the 18 in intended by the manufacturer. (Mr. Crow comments: "The recommendation of our company is to drive the field posts 24 in in normal soils where there is a resistance plate at the surface. Our observations indicate that under these conditions it is *(Continued on page 366)*

HENRY GIESE is professor of agricultural engineering, Iowa State College.

Plow-Built Terraces

By J. M. Steele

I BELIEVE someone should help advance the unfortunate farmer (who gullibly swallowed the propaganda that he could build a terrace with a plow), a portion of those years he has been set back in his progress. So I volunteer to do the heckling.

In his article, entitled "A Terracing Challenge to Engineers", in AGRICULTURAL ENGINEERING for May, Marion W. Clark says (page 188): ". . . but not more than one-half of 1 per cent of the plow-built terraces in Missouri are anywhere near the standards we have set up for minimum specifications of good terraces", and on the same page, "We know that if one is not accustomed to definite standards—and the average farmer starting his terracing is not—there is a tendency to think that almost any kind of terrace is too high and too wide."

Referring to the first quotation, Mr. Clark admits that at least ½ mile out of every 100 miles would pass inspection; therefore, *it is possible* to build a plow terrace. As to the second quotation, I am reminded of a professor that I had in school days. If a student flunked, he considered himself a failure and not the pupil, as he quoted, "If I were a good instructor I could convey my knowledge to the student." Could it be that education of farmers as to what constitutes a good terrace is at fault, not the fact that the terrace was made with a plow?

I would like to take the same liberties as Mr. Clark in writing in a national periodical, and make all my deductions in a small local area. So with apologies to Mr. Clark I quote him further (page 188): "Again let me hasten to add that in no way are we (or am I) attempting to tell any other state what, under their conditions, they should specify for a terrace." (I want a bridge to get home on, too.)

In Mills County, Iowa, we are very fortunate in having very deep fertile soils, with slopes running up to 12 per cent and greater, with a large portion of our cropland averaging 5 to 8 per cent slopes. Our district approves and insists on terrace specifications in line with USDA Farmers' Bulletin No. 1789, with a cross-sectional area of 16 sq ft and with an effective height of 1.5 ft. In our 1944 terrace building contest the winner built a terrace with a cross-sectional area of 19 sq ft and an effective height of 1.8 ft on a slope of 8.3 per cent, and with good farmable slopes, both front and back: This should make anyone, who quotes Missouri Bulletin No. 400 as perfection, hang his head in shame.

Let me at this point clarify my position. I am interested only in having built terraces with adequate height, farmable channel and sufficient capacity—that is, terraces with character. I don't give a hang whether they are built by slave labor, diesel tractors, elevating graders, farm plows, cotton mules pulling V planks, or by Rotary Clubs, so long as they are built and built right.

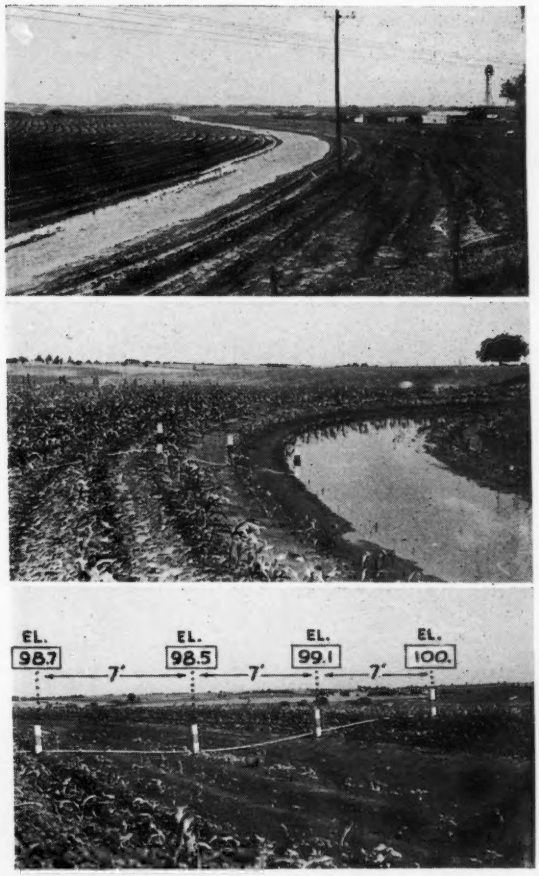
I am sure no one need be concerned about the future of commercial contractors; there is not enough commercial equipment available to construct and maintain this highly seasonable job in 100 years.

I think it is a shame to condemn a method whereby it is possible to terrace a greater acreage in a given length of time than by any other way, there being a rubber-mounted tractor and moldboard plow on almost every farm. And to assist in the continuation of Professor Clark's research, I invite the professor to Mills County (two counties north of the Missouri line), and if I can't show him many, many miles of terraces built in 1945 with the moldboard plow that are equal to Missouri Bulletin No. 400 specifications or better, I will pay all of his expenses plus per diem.

One of the farm implement companies referred to in Mr. Clark's article is doing a commendable job in the step-by-step charts they furnish gratis, with no mention of their products, except the word "plow", which has always been a part of their name. I am positive that farmers who follow this chart won't flunk anywhere near 99½ per cent, even if the yardstick is Missouri Bulletin No. 400.

It may interest Mr. Clark to know that a company which builds and sells a terracing and ditching machine, is using reprints of his article, with underlinings in red ink of statements that a plow can't build a terrace, thereby proving beyond all doubt that their machine will. A new all-time low has been reached in advertising.

All of this banter of phrases does not solve a thing. I recommend to skeptics that they put on the old overalls, mount a row-crop-type tractor on rubber with a two-bottom, high-clearance plow, and fol-



Top: Terrace built with a plow in the spring of 1945, after a 3-in rain • *Center:* Section of a new plow-built terrace after a 3-in rain • *Bottom:* Level terraces built with a moldboard plow in the spring of 1945

This paper was prepared expressly for AGRICULTURAL ENGINEERING.

J. M. STEELE is a farmer district commissioner of the Mills County (Iowa) Soil Conservation District.

low the step-by-step procedure and find out at which point the method is wrong for your particular soil type, everything being subject to improvement.

Mr. Clark, I liked your seven points of a good conservation plan, and too much can't be said that terracing and contour farming is only the bracing to hold the building together, and that proper land use and crop rotations fitted to the capability of the soil are the foundation and principal parts of the farm structure that keeps poverty out.

Defends Good Plow-Built Terraces

TO THE EDITOR:

BEING very much perturbed by a recent report (AGRICULTURAL ENGINEERING for May, page 188) from a midwest state that not more than one-half of one per cent of the plow-built terraces in that state were anywhere near the standards they had set up for minimum specifications of good terraces, it would seem opportune to call attention to the need for good engineering in this particular field.

Instructing a farmer to construct a high-class terrace with the moldboard plow is very much like any other type of instruction in that the instructor must definitely know his subject. You will find yourself faced with the task of assisting the farmer to learn a new technique of using an implement with which he has worked for years. Your first obstacle will be to overcome his lack of confidence in his ability to do a standard job with his existing equipment, for he has undoubtedly seen articles by representatives of conservation contractors' associations in which the plow-built terrace was represented as a dangerous and damaging practice.

It is strange that conservation contractors would favor such propaganda, for in many sections terrace popularity has been generated by the success of good plow-built terraces.

Let us look at the terracing program in a farmer-governed soil conservation district. The district commissioners plot an over-all soil conservation program based upon the technical recommendations of the USDA Soil Conservation Service. Conservation practices, such as terraces, are laid out only on those farms which have a planned land-use program in which rotations are adapted to the soil, slope and erosion conditions.

Rigid specifications are followed in planning and staking the terrace system, such specifications being based on USDA Farmers' Bulletin No. 1789. If the farmer has not attended a demonstration on the technique of using the moldboard plow to build terraces, such instruction is given, and the farmer is furnished a cross-sectional specification for his completed terrace. In those locations where it is a problem to get farmers to stay with a terrace until it is completed, we would consider that there had been a serious lack of instruction and demonstration, or perhaps a lack of qualified instructors.

Assuming that good engineering principles have been followed in the planning and layout of the terrace system, the question can well be asked, what constitutes a good standard terrace? We might list the following points in their order of importance:

1 Capacity, i.e., sufficient channel capacity to care for the runoff, based on a reasonable frequency.

2 Tillability, or the ease with which tillage implements may be operated in channel, inside slope and on back slope. Throughout the corn belt we find farmers using two and four-row planting and cultivating equipment. Also the slopes must accommodate the combine, corn pickers, and the newer haying machinery.

3 Uniformity: the terrace slopes must be uniform in length and slope and there should be no abrupt shoulders on the upper side of the terrace channel.

Yes, it takes time and many rounds to build good terraces. It will average about 32 hr to build one mile with a rubber-tired tractor and two 14-in plows, but to the average farmer the joy of having created this improvement partly compensates for the time. Surely no thinking person would claim that building terraces with the moldboard plow was easy or that it would be a profitable method for contractors to use or that more plows would be sold. Good plow-built terraces like all other good things in life are achieved only after good technical guidance and good workmanship.

Various methods of building standard terraces with the moldboard plow have been developed, and with the proper method, even under unfavorable conditions, creditable terraces can be built. However, it should be understood that in those counties where 75 to 100 miles of plow-built terraces are being built per year, they are not recommended on slopes greater than 8 per cent.

We would have no quarrel with any engineer for his condemnation of a poorly constructed terrace, but we would vigorously defend a good standard terrace against any insult on its parentage. In the last ten years we have found that given sincere, unbiased engineering guidance the average farmer will build a terrace to any desired specification with the moldboard plow and with no telltale birthmarks.

And so we shall continue to appreciate the valuable assistance of the farm implement companies in which they all feature the urgent need of good engineering guidance, and we shall continue to recommend good standard terraces, when they are a supporting practice to good land use, and such terraces may be built with the moldboard plow.

RAY W. JONES.

Choice of Fence Posts

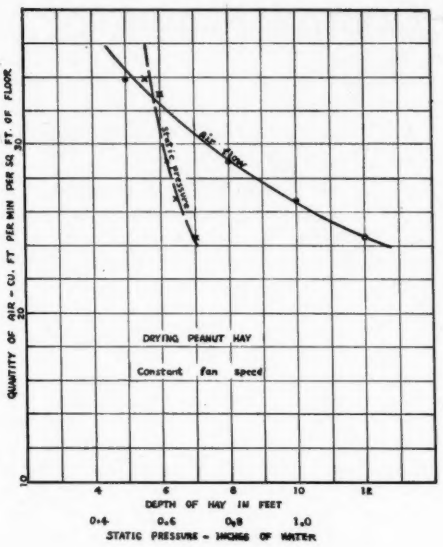
(Continued from page 364)

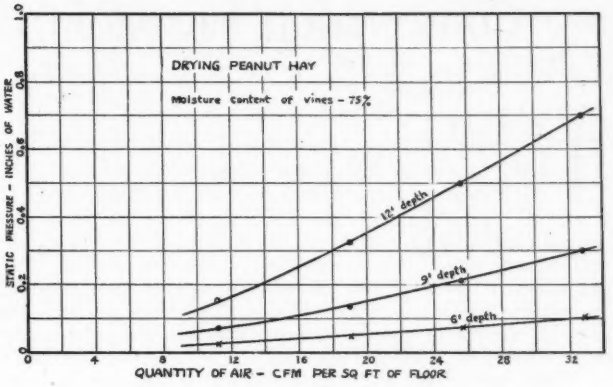
seldom that the steel post is overturned or pushed seriously out of line.") On the other hand, it takes very little more to stress steel beyond the yield point so that there would be no object in setting the post deeper unless the cross section was increased. Wood posts are ordinarily set deeper, and hence, being also larger in size, are capable of carrying much heavier loads. I presume that in calculating the cost of setting a post Mr. Crow has assumed a greater depth for the wood and concrete posts than he has for the steel. Perhaps this should be explained or modified to make the data comparable.

The cost of grounding is a very minor item of one cent only. Generally speaking, a steel post is alright in this respect. I believe, however, that it would need to go considerably deeper that 18 in in Iowa to be of real value during a dry season.

Mow Hay Drying

MANY farmers state that unless the hay crop can be harvested and stored so as to retain the maximum feeding value, modern agriculture will not be on a very sound basis. . . . . There are many phases of mow hay drying that need intensive scientific research before the practice will be commonly accepted. One of our main problems is to learn how to operate a drying system under various weather conditions to prevent growth of mold or mildew; it requires the cooperative efforts of either the biochemict or bacteriologist and the agricultural engineer. —*J. B. Stere* (excerpts from letter)


QUANTITY OF AIR - CU. FT. PER MIN PER SQ. FT. OF FLOOR
DRYING PEANUT HAY
Constant fan speed
DEPTH OF HAY IN FEET
STATIC PRESSURE - INCHES OF WATER


DRYING PEANUT HAY
Moisture content of vines - 75%
STATIC PRESSURE - INCHES OF WATER
12' depth
9' depth
6' depth
QUANTITY OF AIR - CFM PER SQ FT OF FLOOR

Left: Fig. 4 Variation in static pressure and in volume of air as depth of hay is increased • *Above:* Fig. 5 Static pressures required to effect various quantities of air flow through peanut hay of 6, 9 and 12-ft depths

The relation between volume of air supplied and static pressure is shown in Fig. 5 for depths of hay of 6 ft, 9 ft, and 12 ft. The data here shown in graphical form are similar to those for alfalfa. A greater volume of air flow through peanut hay was effected for a given static pressure than in the test with alfalfa hay.

Because of the high initial moisture content of the peanuts, it was considered desirable to use auxiliary heat in the drying. When removed from the dryer, this hay was graded U. S. No. 1 extra green extra leafy peanut hay.

The moisture content of the nuts was initially lower than that of the hay, and remained lower throughout the drying period.

One difficulty was experienced in the drying of peanuts. Because of the sand and dirt which became loosened on placing the vines in the mow, a spot about 3 ft across in the center of the mow was partially sealed off and insufficient air passed through this spot to effect drying.

The data presented here were obtained during the drying of two lots of hay. The results have not been checked by further tests; therefore, definite and final conclusions cannot be drawn.

The following observations were made:

The distribution of air flow through the hay was not uniform. As checked by anemometer, the greatest discharge of air from the hay was around the outer edges. The maximum rate of air flow through the hay at the outer edges was about 75 per cent greater than the minimum rate in the center. This ratio was higher for peanut hay than for alfalfa hay.

It should be noted that static pressure observations and resistance to air flow included only the hay mass and entry into the hay through the slatted floor. No blower, air duct or metering crack losses were included.

Because of greater rates of air flow around the edges than through the center of the hay mass, static pressure required to effect a given air flow probably was somewhat greater than indicated by these results.

At conditions of constant fan speed, when using a centrifugal blower with forward-curved blades, the flow of air through the hay was decreased as the depth of hay increased, and static pressure under the hay was correspondingly increased.

It is very difficult to effect uniformity of air flow through the mass of hay. Very careful placing of hay by manual methods resulted in considerable variation in distribution of air flow through the hay. Under actual farm conditions where less care is generally exercised in distributing the hay, there is probably greater variation in air distribution.

Care should be taken in placing the hay in the mow so that reasonably good distribution of air may be obtained, and caution should be exercised as to the depth of hay placed over the drier at any one time. Additional layers placed on top of hay which has been previously dried should be of less thickness as total depth of hay is increased.

Ginning Cotton

(Continued from page 368)

During the past several years most of the gin manufacturers have built special apparatus for conditioning and cleaning mechanically harvested cotton. These units were installed and tested in several pilot plants in the Mississippi Delta this past season.

A typical view of a late model spindle type mechanical cotton picker is shown in Fig. 1. Figs. 2 to 6 are typical views and diagrams of special apparatus for conditioning and cleaning mechanically harvested cottons.

Even though these experimental units appear to be a vast improvement over existing conventional ginning equipment, we feel that there is still too great a difference in grade between hand-picked and machine-picked cottons.

The Laboratory is carrying the cleaning problem a step further by investigating and developing devices for cleaning the lint and seed after it is ginned. This is virtually a new field in cotton ginning and it is hoped that some worth-while devices and methods will result from these studies. Some work has been done on seed cleaning and drying, but unfortunately our early model combination seed cleaner and drier was destroyed in the recent fire at Stoneville before any extensive tests could be made on it. A new design is being built for our tests this fall.

Thus it can readily be seen that the ginning of this machine-picked cotton is not a problem to be solved by any one group of workers but must be solved by the combined effort of picker and ginning agricultural engineers, agronomists, technologists, and farmers.

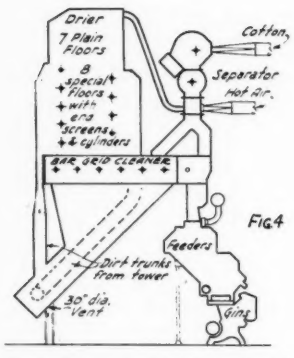


FIG. 4

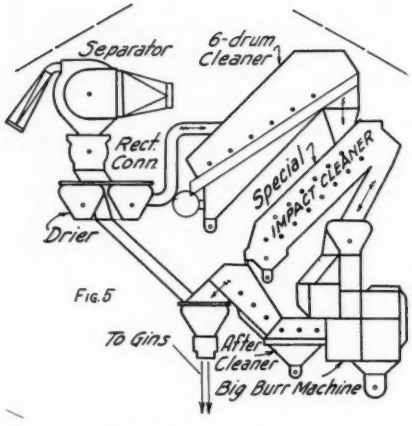


FIG. 5

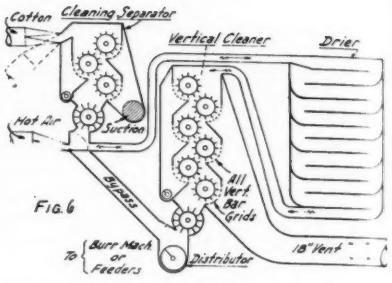


FIG. 6

Fig. 4 Diagram of 15-floor shelf-drier cleaner • Fig. 5 Diagram of impact cleaner and burr machine combination • Fig. 6 Diagram of cleaning-drying-cleaning setup

There is a striking difference in appearance between early cottons picked by spindle pickers and those which have been carefully hand-picked. The longer staple machine pickings at times have a more matted, entangled, and wadded appearance, mottled with quantities of green leaf throughout the locks. Here and there are green, juicy stains upon the fiber and some portions of bark, stems and long grasses. On the other hand, the manual, early harvested clean cottons are outstanding for the natural color characteristics of the fiber, for individuality of locks, and for other general aspects of good quality.

Cleaning tests made by the Laboratory on mechanically harvested cottons disclosed that among the several cleaning and extracting combinations used, the 12-cylinder cleaner, master extractor and extractor-feeder reduced the quantity of foreign matter in 1500 lb of mechanically harvested seed cotton from 113 to 49 lb as compared with 55 lb for the 12-cylinder cleaner and extractor feeder combination and to 64 lb for the extractor feeder alone (Table 1). Thus the elaborate combination removed only 15 lb more than the simple extractor feeder setup. This additional 15 lb of foreign matter removed during the cleaning process improved the quality by only 0.1 grade which was offset by the shorter staple length.

TABLE 1. SUMMARY OF CLEANING TESTS ON MECHANICALLY HARVESTED COTTON

Item of comparison	CLEANING SETUP		
	Extractor feeder	12-cylinder and extractor feeder	12-cylinder cleaner, master extractor and feeder
Foreign matter content, lb*	64	55	49
Grade (Index)	7.7	7.7	7.6
Staple (1/32 in)	35.4	35.3	35.2

*Foreign matter remaining in a bale of 1500 lb of seed cotton.

Concurrently with the extensive work and progress made by the manufacturers on pickers, the plant breeders have been busy on breeding cotton plants suitable for this method of harvesting. Results of ginning tests made by the Laboratory have shown that varietal characteristics play a very important part on ginning efficiency and cotton quality. Greater differences in cotton quality and ginning efficiency were found between hand and machine picked for some varieties than others. Some varieties responded better to the cleaning action of cleaners and extractors than others. From the 21 varieties used in this test for paired lots of hand and machine-picked cotton ginned on the same setup the differences in grade was found to range from 0.7 to 2.0 full grades.

The possibility of successfully using chemical means of removing cotton leaves before harvest time has been under investigation by the ginning laboratory in cooperation with the Delta Experiment Station at Stoneville. Defoliation makes possible an early cotton harvest and in this way releases the crop land at a much earlier date. This in turn gives promise of a greater degree of boll weevil control, in that early working of the soil reduces the food supply of the weevils before they hibernate. It has also been noted that defoliation increases the picker efficiency from 3 to 5 per cent.

These studies are being tied in with ginning tests on mechanical harvesting studies at the Laboratory. This past year's ginning program included a study to determine the effect of defoliation on the quantity of foreign matter placed in the cotton by the action of the spindles on the picker from undefoliated and defoliated fields and the effectiveness of cleaners and extractors on this cotton. The results of these tests are shown in Table 2.

TABLE 2. SUMMARY OF RESULTS FROM THE ANALYSIS OF DATA ON THE EFFECTIVENESS OF THE COMBINATION 12-CYLINDER CLEANER AND EXTRACTOR FEEDER ON GINNING COTTONS FROM UNDEFOLIATED AND DEFOLIATED FIELDS

Field Treatment	Foreign matter removed		Grade		Seed cotton moisture	
	Hand picked	Machine picked	Hand picked	Machine picked	Hand picked	Machine picked
	Per cent	Per cent	Index	Index	Per cent	Per cent
Undefoliated	72	56	5.2	8.5	10.3	18.1
Defoliated	69	62	5.3	7.8	9.2	17.4

In general, defoliation of the cotton plant prior to picking had no significant effect on the quality of the lint from the hand-picked cotton, but where the mechanical picker was used, the test showed that cottons from defoliated fields averaged almost a full grade better than that from undefoliated fields. Leaf particles are embedded in the cotton by the action of the revolving spindles on the picker making them very difficult to remove by cleaning units in the gin.

The tests also showed that whereas 72 and 69 per cent of the foreign matter were removed from the undefoliated and defoliated hand-picked cottons, respectively, only 56 and 62 per cent were removed from corresponding cottons mechanically harvested. A higher proportion of the foreign matter was removed by the cleaning setup when the cotton plant was defoliated before harvesting mechanically. A grade difference of better than one-half grade was also found in favor of cotton mechanically picked from defoliated fields. *(Continued on page 371)*

Resistance of Hay to Air Flow

By A. T. Hendrix
MEMBER A.S.A.E.

VARIOUS methods have been devised to overcome the uncertainties of curing hay due to the vagaries of weather. Some of these methods have been partially satisfactory, but it has been only within the last decade that a procedure of curing hay has been reintroduced which held promise of being effective, reasonably economical in operation and of sufficiently low initial cost to be within financial reach of a large number of relatively small producers of hay. This procedure, now fairly familiar to most agricultural engineers, consists of harvesting the hay somewhat in the usual manner by partially curing it in the field for a period of usually from 4 to 6 hr, and then placing it in the mow where curing is completed by forced-air ventilation.

There are already many farm installations in use for curing hay by this method. Varying considerably in details, and scattered over various localities throughout the eastern and central part of the United States, these installations are generally proving reasonably satisfactory in performance. By far the greatest concentration of forced-air ventilation systems of mow hay curing are at present located in the mountainous sections of northern and southwestern Virginia. Here a combination of soil and climatic conditions favor production of good quality hays, but these same climatic conditions make field curing an uncertain factor.

There are several factors involved in the curing of hay in the mow. Data and information relative to resistance of hay to air flow are essential for the design of systems for drying hay by forced-air ventilation. Such basic available information is very limited, especially as it applies to conditions actually encountered in drying hay in the mow.

In the usual barn installation of a hay-drying system, it is difficult to make measurements of air flow, static pressures, and other factors of performance with the desired degree of accuracy. A small hay mow may introduce variations in air flow and static pressures which are difficult to determine and resultant errors are probable.

In the study of air flow through hay, and static pressure necessary to effect this flow, it was considered desirable to use a mow of such size that depth of hay in the mow would be comparable to that of actual barn storage. The experimental installation for drying hay was made in the agricultural engineering department at Virginia Agricultural Experiment Station. An effort was made to plan the installation so that results obtained would be applicable to planning and designing actual farm installations.

Equipment Used. The hay mow used in these tests at Blacksburg, Virginia, was 10 ft square and 12 ft high, inside dimensions. It was constructed with smooth, airtight inner walls and rounded corners. The floor was of 3-in slats with 3-in spaces between the slats. Under the floor was a plenum chamber 10 ft square and 3 ft high. Air was forced into the chamber by a multiblade centrifugal blower which was driven by an electric motor through a variable-speed drive. Any fan speed from 400 to 1200 rpm was thus available to maintain either desired volume of air flow or static pressure within the plenum chamber. Air discharge from the fan was through a relatively long duct in which honeycomb straighteners were placed so that more accurate determinations of air flow could be made. To reduce the effect of impact of air within the plenum chamber, a transition piece was constructed joining the fan discharge duct and the chamber. Velocity of air was thus reduced to a minimum before air entered the space under the slatted floor. In Fig. 1 is shown the general appearance of the installation, together with a sectional view of the blower, air duct, transition piece and hay mow.

The motor drive was equipped with manual, time-clock, and humidistatic controls. The fan was operated at desired speeds ranging from 400 to 1200 rpm for test observation. Volume of air supplied was determined by a pitot tube traverse of the fan duct in accordance with N.A.F.M. recommendations. An inclined manometer tube was used for pressure determinations. Correction was made for barometric pressure, temperature and relative humidity in computing air velocities in the duct. Simultaneous readings were made of volume of fan discharge and static pressure within the plenum chamber in all tests.

Uniformity of air flow through the hay was checked by an anemometer at the upper surface of the hay and by smoke tests.

Hygrothermograph recorders were placed at the blower inlet and on the surface of the hay. These recorders were checked daily by a hand-aspirated psychrometer.

This paper was prepared expressly for AGRICULTURAL ENGINEERING, as a contribution of the A. S. A. E. Committee on Hay Harvesting and Storage.

A. T. HENDRIX is associate agricultural engineer, Bureau Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, co-operating with the Virginia Agricultural Experiment Station.

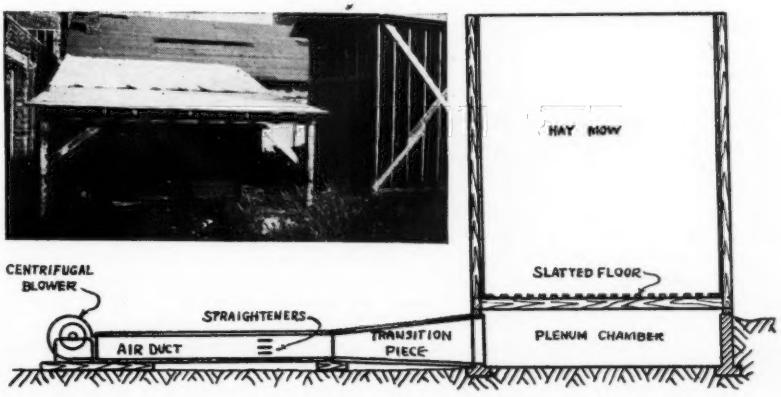


Fig. 1 This shows a picture of the actual installation, together with a sectional view of the test unit for drying hay by forced air circulation

Procedure for Tests. Tests were started late in the summer of 1944. One lot of alfalfa hay and one of peanut hay were dried. Each lot of hay was placed in the mow manually, in small forksful. The hay was spread carefully and was tramped uniformly at depth intervals of 2 ft. Care was taken in tramping along the sides and in the corners to prevent excessive flow of air at these places. A composite moisture sample was taken when each lot of hay was placed in the mow. Openings were provided in the mow walls so that samples could be taken as drying progressed. Samples were oven-dried for moisture determination.

Temperatures at 1-ft depth intervals within the hay were recorded twice daily by thermocouples and potentiometer.

Hay quality and conditions were checked by observation, although quality was not of primary interest in this study.

Static pressures were measured under the floor, and at intervals above the floor equal to one-fourth the depth of the hay. Pressures within the hay were determined by a 1/4-in pipe inserted crosswise into the center of the mow. Pressure within the plenum chamber was found to be uniformly distributed in all tests.

Drying Alfalfa. Alfalfa hay of 51 per cent moisture content (wet basis) was placed in the mow. Hauling of hay was started at 1:30 p.m., and the mow was filled to a depth of 12 ft at 6:30 p.m. with 5650 lb of hay. The fan was operated to supply approximately 20 cfm per sq ft of mow floor continuously, except for an "off" period of 4 hr from 5:00 a.m. to 9:00 a.m. daily. During the drying period, mean relative humidity of the air was 76 per cent. Twelve days were required to reduce the moisture of the hay to a safe storage content of 20 per cent.

Soon after the hay was placed in the mow, observations were made of volumes of air flow and corresponding static pressures in the plenum chamber and at depths of 6 and 9 ft in the hay. Fan speed was varied to obtain the desired range in volume of discharge.

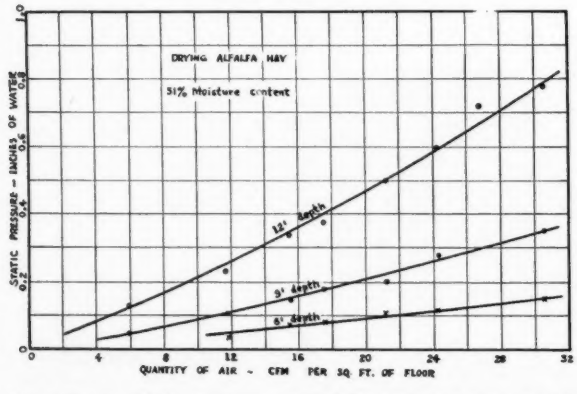
Results obtained by this test are shown in Fig. 2. An inspection of these curves show that for a given static pressure the volume of air flow is reduced by approximately one-half for each 3-ft increase in depth above 6 ft. Also, the static pressure required to effect a given volume of air flow is more than doubled for each 3-ft increase in depth above 6 ft. To effect equal rate of drying of hay, the volume of air supplied must be increased at a greater rate than increase in depth. Consequently the static pressures required for drying hay satisfactorily must be increased considerably as the depth of hay in the mow is increased. The present tendency toward greater depth of hay in drying therefore introduces problems not present when a volume of 10 cfm per sq ft of mow floor area was adequate.

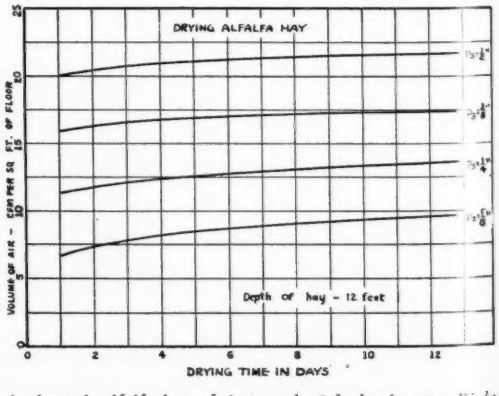
The resistance of hay to flow of air is not constant. To determine the effect of drying on resistance, daily observations were made of volume of air flow and corresponding static pressures. As drying proceeded, the depth of the hay was reduced by settling and the resistance to air flow was decreased. The decrease in resistance of the hay is indicated by Fig. 3 which shows the increase in volume of air flow as the moisture content of the hay was reduced.

The final depth of hay was approximately 8 1/2 ft. The density when dried to safe-storage moisture content was about 5 lb per cu ft.

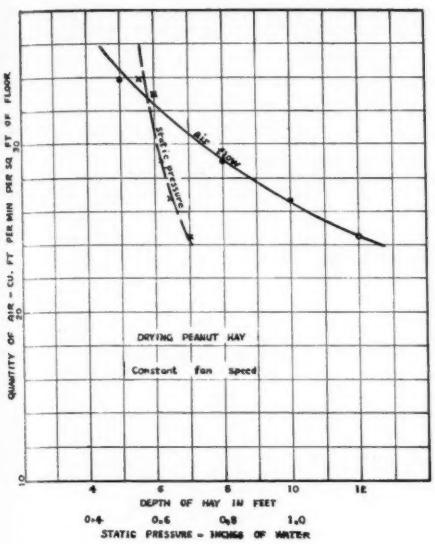
Drying Peanut Hay. Peanuts are an important crop in Virginia. In the peanut-producing areas the vines are used extensively for livestock feed. They are very palatable. The usual method of harvesting peanuts produces hay of not very high quality and of rather poor appearance. As a related part of the investigation of static pressures required in drying hay by forced-air ventilation, a study was conducted to determine the practicability of curing peanuts and peanut hay by this method. Peanut vines with nuts attached, as harvested, were placed in the mow without partial field drying. Peanut vines and nuts from 1 1/4 acres were required to fill the mow 12 ft deep. Weight of peanuts was not obtained. The mow was filled between 3:00 and 6:00 p.m., October 10, 1944. The moisture content of the vines only was 74.5 per cent; of nuts only, 65 per cent. The vines were distributed manually and were tramped as in the placing of alfalfa. A considerable amount of sand and dirt was attached to the vines and nuts. Handling of the peanuts caused this dirt to become loosened and packed in the spot where the vines were pitched into the mow.

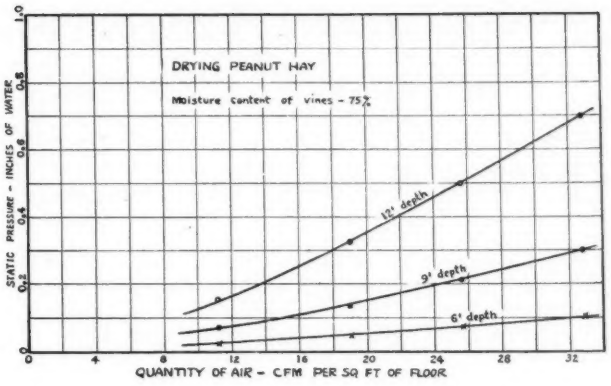
As the mow was being filled, observations were made of volume of air flow and corresponding static pressures in the plenum chamber at various stages of the filling. During this procedure the speed of the blower remained unchanged. The effect of increase in depth of hay on volume of air and on static pressure is shown in Fig. 4. As shown by this figure, as the depth of hay was increased from 6 ft to 12 ft, the volume of air supplied was decreased approximately 29 per cent. At the same time, the static pressure was increased about 19 per cent. These values were observed with no change made in motor-to-fan speed ratio.


DRYING ALFALFA HAY
51% Moisture content
12' depth
9' depth
6' depth
STATIC PRESSURE - INCHES OF WATER
QUANTITY OF AIR - CFM PER SQ. FT. OF FLOOR



Left: Fig. 2 Static pressures required for forcing various quantities of air through alfalfa hay of 6, 9, and 12-ft depths • *Right:* Fig. 3 Increase of volume of air for given static pressures as moisture content of hay was reduced


QUANTITY OF AIR - CU. FT PER MIN PER SQ FT OF FLOOR
Air flow
Static pressure
DRYING PEANUT HAY
Constant fan speed
DEPTH OF HAY IN FEET
STATIC PRESSURE - INCHES OF WATER


DRYING PEANUT HAY
Moisture content of vines - 75%
12' depth
9' depth
6' depth
STATIC PRESSURE - INCHES OF WATER
QUANTITY OF AIR - CFM PER SQ FT OF FLOOR

Left: Fig. 4 Variation in static pressure and in volume of air as depth of hay is increased • *Above:* Fig. 5 Static pressures required to effect various quantities of air flow through peanut hay of 6, 9 and 12-ft depths

The relation between volume of air supplied and static pressure is shown in Fig. 5 for depths of hay of 6 ft, 9 ft, and 12 ft. The data here shown in graphical form are similar to those for alfalfa. A greater volume of air flow through peanut hay was effected for a given static pressure than in the test with alfalfa hay.

Because of the high initial moisture content of the peanuts, it was considered desirable to use auxiliary heat in the drying. When removed from the dryer, this hay was graded U. S. No. 1 extra green extra leafy peanut hay.

The moisture content of the nuts was initially lower than that of the hay, and remained lower throughout the drying period.

One difficulty was experienced in the drying of peanuts. Because of the sand and dirt which became loosened on placing the vines in the mow, a spot about 3 ft across in the center of the mow was partially sealed off and insufficient air passed through this spot to effect drying.

The data presented here were obtained during the drying of two lots of hay. The results have not been checked by further tests; therefore, definite and final conclusions cannot be drawn.

The following observations were made:

The distribution of air flow through the hay was not uniform. As checked by anemometer, the greatest discharge of air from the hay was around the outer edges. The maximum rate of air flow through the hay at the outer edges was about 75 per cent greater than the minimum rate in the center. This ratio was higher for peanut hay than for alfalfa hay.

It should be noted that static pressure observations and resistance to air flow included only the hay mass and entry into the hay through the slatted floor. No blower, air duct or metering crack losses were included.

Because of greater rates of air flow around the edges than through the center of the hay mass, static pressure required to effect a given air flow probably was somewhat greater than indicated by these results.

At conditions of constant fan speed, when using a centrifugal blower with forward-curved blades, the flow of air through the hay was decreased as the depth of hay increased, and static pressure under the hay was correspondingly increased.

It is very difficult to effect uniformity of air flow through the mass of hay. Very careful placing of hay by manual methods resulted in considerable variation in distribution of air flow through the hay. Under actual farm conditions where less care is generally exercised in distributing the hay, there is probably greater variation in air distribution.

Care should be taken in placing the hay in the mow so that reasonably good distribution of air may be obtained, and caution should be exercised as to the depth of hay placed over the drier at any one time. Additional layers placed on top of hay which has been previously dried should be of less thickness as total depth of hay is increased.

Ginning Cotton

(Continued from page 368)

During the past several years most of the gin manufacturers have built special apparatus for conditioning and cleaning mechanically harvested cotton. These units were installed and tested in several pilot plants in the Mississippi Delta this past season.

A typical view of a late model spindle type mechanical cotton picker is shown in Fig. 1. Figs. 2 to 6 are typical views and diagrams of special apparatus for conditioning and cleaning mechanically harvested cottons.

Even though these experimental units appear to be a vast improvement over existing conventional ginning equipment, we feel that there is still too great a difference in grade between hand-picked and machine-picked cottons.

The Laboratory is carrying the cleaning problem a step further by investigating and developing devices for cleaning the lint and seed after it is ginned. This is virtually a new field in cotton ginning and it is hoped that some worth-while devices and methods will result from these studies. Some work has been done on seed cleaning and drying, but unfortunately our early model combination seed cleaner and drier was destroyed in the recent fire at Stoneville before any extensive tests could be made on it. A new design is being built for our tests this fall.

Thus it can readily be seen that the ginning of this machine-picked cotton is not a problem to be solved by any one group of workers but must be solved by the combined effort of picker and ginning agricultural engineers, agronomists, technologists, and farmers.

Conservation Factors in Flood Control Planning

By G. L. Ziemer
MEMBER A.S.A.E.

THE subject of planning and the actual preparation of plans for future work is a much-discussed subject at the present time and intimately connected with every phase of engineering activity. Political, social, economic and extrinsic values are involved. Long-range planning is a healthy condition for it enables the consideration and coordination of each separate individual proposal into one all-inclusive whole wherein each factor may receive its just place of importance and not dominate the end-development to the detriment of the other factors.

Water, one of our great resources, figures prominently in this planning, as well it may. Water has two dominant characters — quantity and quality. It has its destructive phases — floods and droughts — and its beneficial phases as it affects agriculture, aquatic life, navigation, irrigation, hydropower, public water supply, sewage dilution, recreation, sand and gravel, etc. I believe that water in one of its quantitative destructive phases — main stem floods — has received a disproportionate amount of attention over its beneficial quantitative and qualitative phases because of the sensational headlines involved and so has permeated the thinking of many to the extent they believe it to be the only phase of water planning worthy of thought. Because of the headlines, many even fail to realize that floods in the headwaters collectively do more damage to our economy than those in the main river stems. Because of the importance given to flood-control proposals and the seeming lack of consideration given the beneficial phases of water, I wish to discuss the conservation factors in flood-control planning.

Conservation is defined as the "wise use and management of resources." It involves use and so is not related to preservation which does not imply use at all.

Without taking the time to develop the thought, I believe, where it can be shown to be economically feasible, that everyone is in favor of the abatement of damage caused by floods; that floods cannot be eliminated entirely by any means or combination of means under climatologic conditions found in the central United States; that no one method of flood control alone can give complete protection under every possible condition, and that the average annual yield of water from a basin is nearly constant no matter what treatment is given the basin, that only the concentration and distribution may be affected.

The quantitative and qualitative characters of water cannot be considered separately as its conservation includes a variety of uses for the same water. Thus, while quantity only is considered in navigation and hydropower, quantity and quality are both of great importance in public water supply, aquatic life and recreation. It is also overlooked by some that sustained minimum flows, under some conditions, are of greater economic importance than peak maximum flows. The Des Moines (Iowa) Waterworks found it necessary to construct an impoundment to guarantee a certain sustained minimum flow in the Raccoon River for their water supply. The hydropower plant at Ottumwa would benefit from a better condition of sustained minimum flow due to the construction of the proposed Red Rock project. Aquatic life and recreation are often more adversely affected by extreme low flows than by maximum peak flows, although both are damaging.

In our plans for the future, we must recognize more fully that the use of water in its recreational phases is of great economic importance. At the present time this value is either eliminated from consideration because of its indeterminate nature, or fantastic claims are made in favor of it on any pretext without benefit of consultation with authorities who confine their activities to that field of water use. True, the full value of the recreational phases of water are indeterminate, yet we do know how much people pay for it, and on the theory that it is worth as much or more than they pay or they would not indulge, we can set minimum values which it is logical to believe are exceeded. For recreation purposes, an impounded body of water should be of maximum obtainable quality and the stage should be held to the least possible variation from a fixed elevation. Just any body of water is not enough. The advertising literature of Minnesota claims a value in tourist trade of $400 per acre of recreational waters. Lake Wapello in Davis County, one of Iowa's successful artificial recreational lakes, enjoys a use in excess of 150,000 day visitors per year. At the rate of 10c per day-visit, the rate charged by some states as an admittance fee to their parks, the annual benefit exceeds $15,000 per year. Capitalizing this at 4 per cent and assigning 50 per cent of this to the water area, a low figure, we get a value of $625 per acre of surface area for this recreational lake. Following this same analysis through on another Iowa artificial lake, Lake of Three Fires in Taylor County, we get a value of $100 per acre of water-surface area. Both lakes have the same stage, depth, etc., characteristics. Lake Wapello contains water of highest quality; Lake of Three Fires contains water highly charged with silt and is usually roily and dirty. People do not like to swim in it and aquatic plants and animals cannot live successfully in it. Not every body of water, even when constructed primarily for the purpose of recreation, can have the same recreational value. Any random body of water, just because it is water, will not of itself justify the claim that it is of recreational value. There are approximately 15,000 miles of rivers and streams in Iowa. With an equivalent mileage assigned to our lakes, as evaluated by fisheries men, we have 5,000 miles of fishing waters for which the people pay $240,000 per year for the license to fish. This amounts to $48 per year per mile of fishing water in revenue. The benefits must be equal to, or exceed, the revenue or people would refuse to pay that much for it. Capitalize this at 4 per cent and you get a valuation of $1,200 per mile of fishing water. This evaluation of benefits from waters developed and managed for the maximum recreational production is, in my opinion, as sound as the evaluation of benefits due to the abatement of damages from anticipated future flood conditions on the main stems of our rivers. Please recognize that these are average valuations only, and that in actuality there is an almost infinite range between those waters of minimum and those waters of maximum valuation. These values cannot be applied to any body of water for recreational uses by anyone, except by those whose only business it is to do such a job. Call in an aquatic biologist, an ichthyologist, and an experienced park man when confronted with these problems.

I will attempt in this paper to bring out the more obvious factors in the various methods employed to control

This paper was presented at the annual meeting of the Iowa Engineering Society, February 6, 1945.

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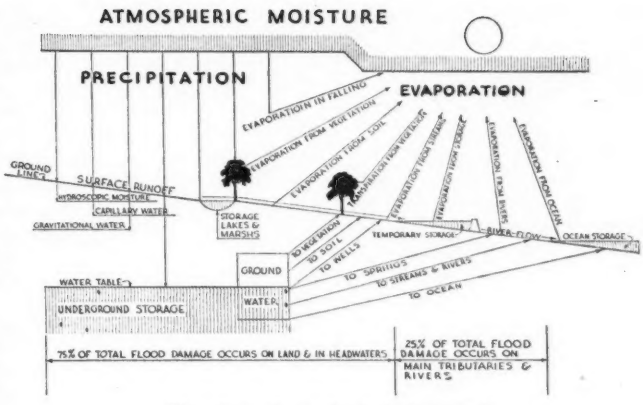
damages from floods, i. e., (1) water retention on the land, (2) head water storage and retardation, (3) main stem reservoirs, (4) levees and channel works, and (5) nature's method by out-of-bank storage, and to evaluate the effects of these various methods on the other uses of water.

The retention of water on the land where it falls as rain has been claimed by its overzealous advocates to be the one answer to all the management problems in water use. I do not subscribe to such all-inclusive claims because of the near impossibility of adoption of enabling works to accomplish that end on every acre of land, and because of the occurrence, at certain times, of conditions under which land treatment is not wholly effective in the control of runoff water. It is claimed, however, that the retention of water in and on the land will extend the duration of runoff periods and reduce the height of certain flood crests, and thus materially benefit main stem flood control works. It will afford a large measure of flood protection on the land and headwater areas where the majority of flood damages occur. Howard L. Cook of the U. S. Department of Agriculture, in a paper entitled, "Flood Abatement by Headwater Measures", states: "When most people think of floods they visualize great rivers, like the Mississippi, the Missouri or the Ohio, overflowing wide valleys, driving people from cities and farms, causing enormous damages and often taking many lives. This is only natural because these great floods are spectacular and claim the headlines of our daily papers. But there is another flood problem that isn't called to public attention by newspaper headlines. This problem arises from the vast aggregate damage caused each year by the frequent flooding of the myriad headwater streams draining our broad agricultural regions. These damages occur on minor tributaries that drain anywhere from a few to several hundred square miles. They result mainly from the destruction of crops on fertile bottomland fields, damage to agricultural property and the deposition of sediment in channels and on flood plains. This is the *headwater flood problem.* Year in and year out the small headwater valleys of the agricultural regions are subject to damages that *exceed,* in the aggregate, the damages done in the major valleys." Mr. Cook carries through an analysis of a hypothetical, but typical, basin of 10,000 sq mi in a rolling agricultural region and arrives at a distribution of damages as follows: 15 per cent city damage, 6 per cent main valley damage, 4 per cent principal tributary damage, and 75 per cent headwater valleys damage. The damages are those caused by *water* and do *not* include sediment damages.

L. C. Crawford, district engineer at the Hydraulics Laboratory at Iowa City, furnishes the figures that 400,000 acre-feet of water flowed past the gage on the Iowa River at Iowa City during the period of May 20 to 29, 1944, and that this water carried slightly less than 1,000,000 tons of sediment. During the second high-water period from June 14 to 23, 1944, a quantity of 370,000 tons of suspended matter was discharged. On the basis that an inch of top soil from one acre of land weighs 150 tons, the irreplaceable soil loss in those particular 20 days would be equivalent to an inch of soil on each of approximately 8,500 acres of valuable farm lands in the Iowa River basin. After the 1944 floods, the state soil conservation committee reported an estimated soil washaway in excess of $150,000,000 for Iowa. These sediment loads are actual measurements, not guesses. They are not of spotty occurrence, but are statewide. Consider actual silt rate measurements as high as 264,000 tons per day on the Little Maquoketa; 206,000 tons per day on the Skunk; 198,000 tons per day on the Des Moines; and so on. The control of water on the land where the rain falls, which could be called the control of infinitesimally small floods, and which is the conservation or wise use of water for agriculture, goes hand-in-glove with soil conservation. They are the most important factors in the economy of Iowa today.



This chart shows the hydrologic cycle

Let us reconsider for a moment in order that we may fully appreciate the situation. The estimated 75 per cent of the total over-all flood damage, which occurs on the land and in the headwaters due to the effects of the water alone and the added loss of $150,000,000 worth of top soil from Iowa land alone certainly indicates to me where the beginnings in water control should be made.

The control of these myriad infinitesimally small floods on the land where the rain falls, which is the conservation of water for agriculture, is accomplished by land treatment involving contour farming, strip cropping, terracing and improved agricultural practices. Land treatment, according to Mr. Cook, does these things: (1) It increases the rate at which rainfall enters the soil, (2) it increases the amount of water stored on the surface of the land during and after storms, and (3) it increases the capacity of the soil to store water.

The control of water on the land where it falls as rain will markedly improve the quality of the water in our streams and rivers by the lessening of the silt load and so benefit the aquatic life, public water supply, and recreation. It will improve sustained minimum flow, and so benefit further the use of water for aquatic life, hydropower, public water supply, sewage dilution and recreation. It will increase the amount of gravitation water and so benefit the well-water supply and pumping heads. It comes nearer than any other one method of water control to that much-desired (and much-abused term) "multipurpose control."

Hon. Claude R. Wickard, formerly Secretary of Agriculture, said in a speech: "On farms where conservation farming is practiced, row crop yields have increased ten to fifty per cent per acre. Yields per acre of small grains have increased 25 per cent and livestock capacity per farm has increased up to 100 per cent." When productivity and capacity per unit of capital plant is increased, profit chance very definitely is appreciated. Applications of soil conservation and the retention of rainfall on and in the land is approximately ten years old. Ninety per cent of the job remains to be done. You may think that the application of such methods will be too slow to affect the problem before it is too late. I attended a meeting a short time ago in which a progressive farmer was addressing the assembly. He pointed out concrete examples of how such practices

increased his net income and how he could no longer afford to operate without the extra monetary benefits the application of land and water conservation gave him. He stated that the best way to jolt a farmer was to slap him in the pocketbook and that was just what soil and water conservation did; that farming was going through an evolutionary change from a mode of living to a business venture in which cost and return studies must be made and applied; that this very factor of profit or loss would cause acceptance and application of conservation at a very fast rate. Already approximately one-half of Iowa is organized into soil conservation districts, under the Iowa law provided for such organization, and progress in the application of these principles is progressing at the maximum rate possible under war handicaps. Many of the remaining counties are on the road to organization. The end of the war will see tremendous immediate strides being made in this field. Farmers cannot afford to pass up the added profit such practices give them.

SURFACE RUNOFF DECREASED WHEN ABSORPTION AND INFILTRATION ARE INCREASED

Reference to the hydrologic cycle as delineated on the accompanying chart shows that surface runoff is decreased when absorption and infiltration are increased, which results in greater benefit in the control and use of water for vegetation; soil moisture availability, shallow-well water supply and decreased pumping heads, and augments minimum sustained stream flows by increasing subsurface runoff to springs and streams.

The National Resources Planning Board conducted an investigation on the Des Moines and Skunk Rivers and in 1943 published their report of that investigation under the title "Problems and Future Development of Water Resources in the Des Moines and Skunk River basins in Iowa and Minnesota." The summary of that report sets out the most important water problem of these basins in this order: (1) More water in the soil for crop production; (2) more water in the ground for maintaining supply to shallow wells; (3) greater sustained flow in streams during dry weather.

"Improvement in soil moisture for crops and supply of ground water for wells which are depended upon largely for domestic supplies, both rural and urban, will depend principally upon better land practices. Extensive adoption of soil conservation practices, such as crop rotation, contour farming and other suitable treatments, is indicated as a principal objective of future planning throughout the basin. In addition to the on-site benefits of better soil conditions and reduction in erosion, there would result substantial downstream benefits from reduction in flood flows and less sedimentation."

"Attainment of better sustained flows in the streams during dry weather (item 3) is probably one of the most pressing needs of the area."

It will be noted that these major problems of the basins, together with the occurrence of the majority of flood damages, and the loss of the soil from the land, are all headwater problems; they concern the "little waters." Conservation of the soil and water in the areas where the rain falls are the areas that should receive our attention. The "little waters" are our most important problem and are the most amendable to satisfactory management and control.

The effect of headwater treatment on tributary and main stem floods is often the topic of debate. These arguments concern quantity of water and peak crest stages. I would like to point out that quality of water is an important consideration in flood damage. You probably have all seen deposits of silt on the lower drainageways of cultivated fields, oftentimes of such depth that the crop was buried beneath it as were the fences where it spilled out to clog highway ditches. Control of our "little waters" improves the quality of flood flows and thus lowers the amount of damage from floods.

The "little waters" are our important problem!

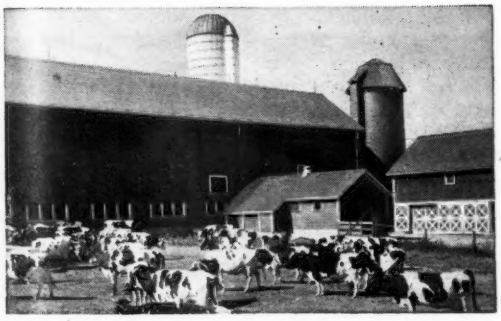
Flood control by headwater storage and retardation is accomplished through natural lakes, ponds, marshes and sloughs and may be extended by artificial construction of similar areas. It is an important factor in the control of floods on tributary streams, but has only small effect on main stem floods because of the limited area available or possible in our agricultural economy. The greatest potential value of headwater lakes lies in benefits to other than flood control factors because retention of water for flood control is contradictory to the maximum development and management possibilities in the other water uses and which are of greater economic and social importance. The beneficial effect on low stages that once existed because of the headwater pond, marsh and slough retardation of water has practically been eliminated through the efficient artificial drainage of land for agricultural purposes. Re-establishment in full of the original area of ponds, marshes and sloughs is not considered possible because of the tremendous investment now tied up in these lands. It can only be hoped in the future that proposed drainage projects will be more fully evaluated so that consideration will be given, not only to the benefits and damages accruing within the confines of the proposed district, but also to benefits and damages caused to downstream area, such evaluation to include recreational values as a tangible item. An example of the faulty evaluation of the benefits and damages accruing to a proposed drainage project was that contemplating the drainage of Tuttle Lake on the Iowa-Minnesota line. Tuttle Lake with several adjoining lakes in Minnesota is the headwaters of the east branch of the Des Moines River. This lake, and those to the north, form a great natural reservoir of 5,000 acres for the pondage of storm water from a watershed of 92,000 acres. Drainage of the lakes was proposed by Minnesota landowners to facilitate reclamation of wet farm lands. In actual natural operation, this chain of lakes discharges into the Des Moines River, at or below channel capacity, for periods of several months, that quantity of water which might be impounded in a week or less. Any greater rate of discharge would result in ruinous floods over wide, valuable, agricultural bottomland here at the very headwaters of a river. If this drainage scheme had gone through, downstream flood damage would have been greater by far than upstream benefits. Yet it was considered as a feasible project for the Minnesota drainage district as the net benefits within the district exceeded the cost. The fact that the recreational value being destroyed and the downstream flood damage caused by the drainage of these lakes exceeded by far the benefits expected to be derived from the drainage of lands for farm crops was probably not even considered or thought of.

MANY DRAINAGE PROJECTS ARE SOUND AND JUSTIFIABLE UNDERTAKINGS

Many drainage projects are sound, prudent, absolutely justifiable reclamation undertakings — and many more are unsound, promotional schemes which bankrupt both farmers and bondholders.

The legal aspects of the drainage of land by establishment of drainage districts is made as easy as it is humanly possible under Iowa law governing the formation of districts. County boards of supervisors are given the power and authority to establish districts and to cause to be constructed such works as are *(Continued on page 376)*

INSIDE STORY of a GRADE-A RATING



INSIDE AND OUT...Flintkote gives you extra years of service on the farm.

The photo at top shows the type of interior described in the text. Installed quickly and economically, this interior finish is in to stay... to help... to raise the rating of this farmer's barn.

THE EXTRA YEARS OF SERVICE COST NO MORE!

FLINTKOTE BUILDING MATERIALS

Frequently the story of higher ratings in dairy barns is an *inside* story... of cleanliness, insulation and ventilation. Ratings... and profits... jump when interiors are properly installed and maintained.

In providing clean, healthful quarters for your herd, Flintkote Asphalt Sealed Sheathing can be a big help.

Install it over dusty cobweb-catching rafters and walls. Coat it with asphalt-base aluminum paint. You have a smooth, light-colored interior wall that's easy to clean... and one that will retain sufficient animal heat to allow your ventilation system to keep moisture content at a healthful level.

And this is only one of many Flintkote products that are a big help in large and small jobs on the farm. Write for complete information... it's yours for the asking.

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Fire-resistant Asphalt Shingles—Durable, Fire-proof Asbestos Sidings—Insulated Brick Sidings—Easily applied Roll Roofings—Cold Process Built-up Roofs—Dampproofing and Waterproofing Materials—Decorative Insulating Board, sealed sheathing, lath and Rock Wool Insulation.

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Atlanta • Boston • Chicago Heights • Detroit • East Rutherford • Los Angeles
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Flood Control Planning

(Continued from page 374)

deemed necessary "whenever the same will be of public utility or conducive to the public health, convenience, or welfare (Sec. 7421)." And to remove any possible doubt, Sec. 7422 of the code reads: "The drainage of surface waters from agricultural lands . . . . . shall be presumed to be a public benefit and conducive to the public health, convenience and welfare." Every rural Iowa acre is considered agricultural land for the purpose of this section. I think it is time drainage and levee districts are made to rest on real benefits, fairly evaluated, and not on presumption. There are indications that another drainage and levee district boom is starting in Iowa based on present inflated prices. Some of the proposals will be wisely conceived and executed, others will not be. I believe engineers will be rendering a valuable service to their clients and to the welfare of all the people if they consider and evaluate every possible use of the water, both at and downstream from the site, and the effect that construction of the proposal will have on such uses.

In the case of engineers in the drainage and levee field, let it be said of them that they are as wise as the old-time drainage engineers, who, it is claimed, would never accept the bonds of the district as payment for their services.

The development and management of an impoundment of water, either for permanent storage or temporary retardation, can, for greatest effectiveness, serve only one dominant water use. Contribution to other uses of the water are only incidental and each phase of use can best be served by a separate and distinct impoundment developed and managed exclusively for the greatest benefit. Society certainly should develop, within economic means, the greatest possible benefit of every phase of water use, but not in one impoundment.

MULTIPLE-PURPOSE RESERVOIRS OFTEN HAVE GREATER POLITICAL THAN PRACTICAL VALUE

Multiple-purpose reservoirs often have greater political than practical values, and that applies equally to either upstream or main stem proposals. In my opinion, the multiple-purpose principle has been so abused in its application that I start looking for a joker whenever I hear the term or see it in print. And, from my viewpoint, it is generally found in this wise: It is proposed and advocated to afford benefits in one of the dominant phases of water use, but investigations and studies reveal that it cannot be justified from the economic standpoint because benefits of the proposal in that water-use phase do not exceed the cost and carrying charges. To show a favorable benefit cost ratio, part, and oftentimes a substantial part, of the costs are charged up against incidental purported benefits which can be charged off as non-recoverable benefits in the guise that they "promote the public welfare." Navigation and flood control are usually the victims to which non-recoverable benefits are assigned. The summation of costs, in all the proposed projects, which are assigned to flood control makes one wonder if it would be cheaper to give a river's flood plain back to the river and stop human encroachment upon it. When I attempt to interpret this "promotes the public welfare" factor, I always arrive at the same answer—private gain at the public expense. The private interests which derive gain are the commercial river transportation companies and the real estate holders. To take a case close to home, now authorized as a postwar project, let us examine the flood benefits assigned to the lower Des Moines River basin in the economic evaluation of the Red Rock proposal. A survey disclosed an estimated average flood damage of $2.50 per acre per year to overflow agricultural lands. The farmers on the river bottom figured that out long ago. John Doe, farmer, when he bought his land, paid $100 per acre for that part of his land above the flood plain and $50 per acre for that part subject to overflow from the river. He only paid $50 per acre, or half as much as he paid for the upland part, because of the fact that it did flood occasionally and he knew it. He bought it with his eyes open, fully aware that he would lose a crop now and then. He financed by borrowing money at the local bank against a mortgage on the land. The banker charged him 5 per cent interest on the loan. By simple arithmetic, the carrying charges on this overflow land is $2.50 per year less than it is on the non-overflow land. He saves $2.50 in expense and gets $2.50 less in returns. He is breaking even with the river and not sustaining any loss that he hasn't already been compensated for. Of course, if someone comes along and stops the river from overflowing this land, he will realize $2.50 more in returns and it is a good deal for him, especially when it doesn't cost him anything for the added return. His real estate immediately appreciates in value and he is benefited privately at the public expense.

Main stem flood control reservoirs have, as their primary purpose, the abatement of downstream flood damages by their regulatory effect on discharge rates and must, for the most complete measure of effectiveness, be emptied in the quickest possible time to make storage available for a possible recurrence of flood flows. Such a necessary management policy is not compatible with storage in the impoundment for recreation, hydropower or irrigation. The greatest benefits to other uses of water, incidental to the control of floods, occur not in the reservoir itself but in the reaches of the river below the impoundment due to the regulatory effect on the river stage. The inclusion of a so-called "conservation pool" in the reservoir area is of debatable value for recreational uses because of extreme stage fluctuations and unsatisfactory water quality. The assignment of this added volume to flood storage might oftentimes provide sufficient additional flood benefits to justify the construction of an independent artificial lake developed and managed exclusively for the maximum recreational returns. The permanent pool included in the plans of many flood-control reservoirs and commonly called a conservation pool has its greatest application, in my opinion, as a sediment-storage allocation of the total impounding capacity. It is sound policy to expect that sedimentation will take place and to allow so many acre-feet of the capacity to that use in order that the economics of the project will not be upset by the loss of impounded volume as sedimentation progresses. To expect any other great use of the permanent pool is the result of optimism and not of the sound evaluation of facts as they are known.

Levees and channel-improvement works will be considered only briefly, because when water control reaches this stage, every beneficial use of the water is passed on in the great desire to get rid of the water in the quickest manner possible, even if it must be dumped on the areas downstream to their great detriment. Potential water use has passed from a conservation to a squandering stage.

I would like to say a few words in regard to the evaluation of the feasibility of proposed channel-straightening projects. Generally the abatement of flood damages is the only consideration, all other uses of the water being completely disregarded and ignored. Straightening of rivers and streams usually results in the complete destruction of water uses in the recreational phases, especially fishing. There is ample parol evidence that many of our rivers and streams, before being straight- *(Continued on page 378)*

Cold-weather Friends FOR FARMERS

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			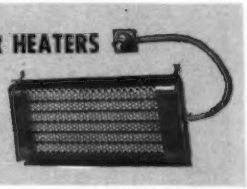
hotbeds plant houses water pipes brooders gutters and drains floors and walks *	sterilizers workshop greenhouses milk house drying ovens incubators *	tanks and troughs sterilizers water heaters *	workshop greenhouses garage milk house *

*And many other places where an ingenious man can install them

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The safety, convenience, and dependability of electric heat are well known to industrial users. These qualities should be familiar to the farmer, too, who combines many types of operations in one day's work, and has need of "spots" of heat in out buildings and widely separated locations. Proper selection and installation of tested, dependable electric equipment, such as that supplied by General Electric, reduces heating problems to the mere flick of the switch. The bulletins mentioned above, and our 60-page booklet (GED-650B) which supplements them, give detailed information on the application, installation, and use of this heating equipment. Send in the coupon now.

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DAVENPORT, IOWA

Flood Control Planning

(Continued from page 376)

ened, were excellent fishing waters, worth perhaps in excess of $1,000 per mile to society for fishing purposes. Channel straightening almost completely destroys that value. Now the ordinary citizenry in those parts of Iowa where channel straightening was most extensively carried out are beseeching the state to construct, with public funds, artificial lakes for recreational purposes to replace the very fishing potential which they themselves were instrumental in destroying in their rivers and streams. And the channel straightening continues.

Nature herself had a method all her own to handle main stem floods in the days before the advent of civilization on her water basins. And there were high floods in those days, too, even though grass and trees grew on the watershed and the ground was not plowed up and down hill. That control method was retardation by out-of-bank storage. The rivers still try to use their flood plains for this purpose now, but humans give them a good cussing when they do. This method of control is now precluded by human encroachment on the flood plains of the rivers. It is because of this encroachment that other man-made main stem developments for flood control are advocated and constructed.

Water, because of the variety of uses to which the same quantity is put, belongs to all of the people for every reasonable use and not to the property owner through or over whose land it flows. No interest, for financial gain or otherwise, has a right to destroy or render useless any of water's potential benefits to the public. If a development for the benefit of one water use destroys or depreciates its value to other phases of water use, replacement facilities to correct such destruction or depreciation should be made in the vicinity just as highways, railroads, etc., are relocated as part of the job and figure in the job costs. The ratio of benefit to construction and maintenance cost on too many projects is so near unity that the whole undertaking would become infeasible if damages to other phases of water use were included in the cost evaluation.

Water is the orphan stepchild of the whole natural resource family. Its whole history has been one of exploitation for special interests for financial benefit, with the public allowed to enjoy whatever crumbs that might be left.

I doubt if any thinking person can subscribe to the idea that a river is worthless and the water is going to waste unless it is dammed, diverted or canalized.

Air, sunshine, land and water are the four indispensable natural resources that sustain life. Air and sunshine are, substantially, beyond our control and influence. Land and water may be amended by management to provide a better or a worse environment for human beings. Let us hope we have the ability and the conscience to so evaluate our management proposals that human beings, all human beings, may enjoy the benefits of a better environment.

New Literature

"BEARING APPLICATION." New Departure, Division of General Motors Corporation, Bristol, Conn. Copies may be obtained on request to company by specifying booklet BA.

This book is one of a series of New Departure treatises for designers on the fundamentals of ball bearings. With 78 drawings and a clear and orderly description, the book covers among other subjects the most important fundamentals of bearing mounting applicable to all types; pre-loading methods, their effect on housing fits, the effect of press fits on preloading, the effect of preloading on bearing life; bearing creep; the use of duplex, shield and sealed bearings, etc. A companion book, entitled "Details of Design," issued last year and covering the details of shaft and housing design for ball bearings, will also be supplied on request.

"We don't want anyone else pulling the strings, son"

A puppet show is good entertainment, Jimmie, but it's also a fine example of something we don't want to have happen to us.

People who are regulated and regimented and bossed are no better off than those puppets. They can't move unless somebody else pulls the strings.

That isn't what your Mother and I are bringing you up for, Jim. It isn't what we want for any American boy or girl.

If you carry on with the farm when you grow up, as we hope you will, we want you to be free to *run* things —and not have to plant, harvest, buy and sell according to orders.

If you decide to be something else—a doctor, lawyer, business man, or minister for example—we'd want you to be free to go right ahead with whatever you had planned.

Some folks seem to think that, just because this country has been a free land of free opportunity for around a hundred and fifty years, it's going to stay that way without anybody doing anything more about it. That's mighty dangerous thinking, son.

Any kind of unnecessary regulation or control is a sneak-attack on our American brand of freedom.

Every war restriction that isn't promptly dropped when it's no longer needed carries the seeds of further regimentation.

Every spree of government spending —not justified—results in heavier taxes and lowers our standards of living.

I don't think our American farmers, merchants, inventors and other pioneers made this the greatest country in the world because they were smarter, or luckier, or better off than other people in other lands.

I think it was because they were FREE. Free to think what they wanted to think, go where they pleased, do what they wanted to do. Free to get ahead in their own way.

And the future of America, Jimmie—*your* future and that of the millions of boys who are coming back after fighting dictatorships and regimentation and slavery in other parts of the world—can be even greater and more enduring than the past, if we STAY free.

YOU JUST CAN'T BEAT STEEL ROOFING

Practically any building on your farm can be improved by installing a steel roof. You can gain an attractive appearance, fireproofing, stormproofing, durability and a low maintenance cost.

The initial cost of a steel roof is as low or lower than that of competitive materials. It costs less to apply steel roofing, and you often enjoy lower insurance rates.

Ask your Republic dealer about steel roofing, and how it can help you. Ask particularly about Republic Triple Drain, the perfected channel drain type of roofing. It is made of prime sheets. There are no sharp bends to cause galvanizing to chip or crack.

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The Army-Navy E flag waves over 7 Republic plants and the Maritime M floats over the Cleveland District plant.

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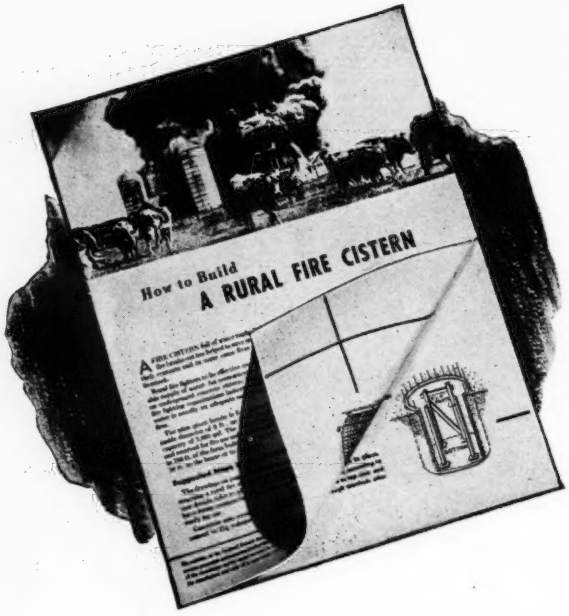
How to Build a
CONCRETE FIRE CISTERN
on the Farm



Every farm will be safer with an adequate fire cistern.

Send for free folder, *"How to Build a Rural Fire Cistern."*

It contains step by step details showing how to build a long-lasting concrete fire cistern of 3,000 gallons capacity. Free in United States and Canada.

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BUY AND KEEP VICTORY BONDS

"Improved Farm Implements"

To The Editor:

I recently had occasion to look through the Department of Agriculture report of the Commissioner of Agriculture for the year 1866. There are 33 pages of this report devoted to an essay on "Improved Farm Implements" by Edwards Todd of New York City.

This was an exceedingly interesting essay to me, and, although I know some members of the American Society of Agricultural Engineers are familiar with it, there are many who probably do not know of its existence and would also be interested in some of the information in this old publication. Although nearly 80 years have passed, one could read parts of this essay and think that it had been written in the last few years. For example, I quote here the introduction to this essay and also the part of it devoted to agricultural engineers:

"The object of this essay is to advise the farmers of our country of improvements in some of the implements of husbandry, to facilitate the labors of farm and garden. The developments in improved farm implements during the last ten years have been really wonderful, and the man who has not kept himself posted in regard to the new inventions of hand tools and horse implements is filled with astonishment when advised what ingenious inventors and skillful mechanics have accomplished, and what they are now doing to relieve farmers of the heavy and irksome drudgery of the farm. Indeed, the improvements in agricultural implements have been characterized by such eminent ability, that at the last international exhibition it was repeatedly observed that the Americans by their superior ingenuity, had beaten the English on their own ground, in the exhibition of superior implements of husbandry.

"My aim is to give illustrations and descriptions of the best hand tools and horse implements that are now manufactured throughout the United States. Of course there are many really meritorious horse implements that I cannot notice; and before publication there may be others brought out that will far excel anything illustrated and described in these pages. Skillful and experienced mechanics are not only surprised to see such a commendable spirit of invention among their fraternity, but they are astonished at the inventive ingenuity and skill of intelligent farmers, who aim to economize labor and appropriate the forces of the farm to the best possible advantage.

"The exceedingly high wages required for manual labor in this country has prompted farmers to bring out machinery with which they can perform the heavy labor with teams, which are far more capable of exercising muscular force than human beings. Only a few years ago a farmer was required to employ, feed, and pay a large gang of strong men to do a little work which could all have been performed in a shorter period of time by means of his idle fat horses, if the necessary machinery had only been provided. But now we see one man and a boy, with a single team, accomplishing tasks which formerly required a score of faithful and strong laborers to perform; and by means of a team and improved machinery a given piece of work is accomplished sooner and in better order than when men performed the labor and fat horses stood idle in the cooling shade. Many of our implements, it is true, have not been brought to that degree of perfection which is desirable, yet they may be classed among our most efficient machines ever invented."

* * *

Agricultural Engineers

"What wonders have been wrought in farm implements in the brief space of forty years! The young men of our country cannot appreciate the great contrast between a complete set of farm implements forty years ago and the hand tools, implements, and machinery required at the present day

(Continued on page 392)

The Japs supplied the floor drains . . .

for the Navy's "Quonset" Barn

It's just one more story of "Seabee ingenuity" . . . that unique secret weapon that recently caused a Japanese officer to exclaim, "Impossible!" when he saw how the Navy's Construction Battalion had converted Iwo Jima into a great air base.

This time the problem was much simpler, but it illustrates the point. The Seabees of the 103rd Naval Construction Battalion were given the assignment of providing a complete dairy farm on Guam for a herd of 65 cows, to furnish fresh milk for wounded men on this advanced base.

First step, after determining requirements, was to requisition the "Quonsets"—those great all-purpose buildings produced by Great Lakes Steel and put to a hundred and more uses in the Pacific. A 40′ x 100′ "Quonset" was requested for the main barn, another for the farm executives' living quarters and office building, and several smaller 20′ x 48′ "Quonsets" for equipment shelters and refrigerated feed and grain storage buildings.

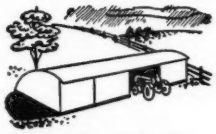
The buildings arrived, were erected on their foundations with the amazing speed and simplicity that Stran-Steel framing makes possible in "Quonset" construction. But the neatest trick of all was in the dairy barn, where "Seabee ingenuity" had tackled the problem of providing floor drains. Here, set in the concrete with tops pierced and open ends connecting to tile pipes under the floor, were Jap 8-inch mortar shell cases which the Seabees had salvaged for the job! Thank you, Hirohito!

Speedy to erect, available in varied lengths to meet specific needs, sturdy and adaptable—the famous Stran-Steel-framed "Quonsets" are the answer to tomorrow's fire-safe, efficient, low-cost farm buildings.

STRAN-STEEL FARM BUILDINGS

Stran-Steel is the framing material used in the tens of thousands of "Quonsets" produced for the Navy by Great Lakes Steel Corporation. It is absolutely uniform in quality—has none of the flaws, weak spots or variations in quality found in conventional types of framing materials. Tomorrow's better farm buildings, like today's great "Quonsets," will be produced by Great Lakes Steel Corporation around the efficient framework of Stran-Steel.

MAIN BARNS, LIVESTOCK BARNS AND POULTRY BUILDINGS



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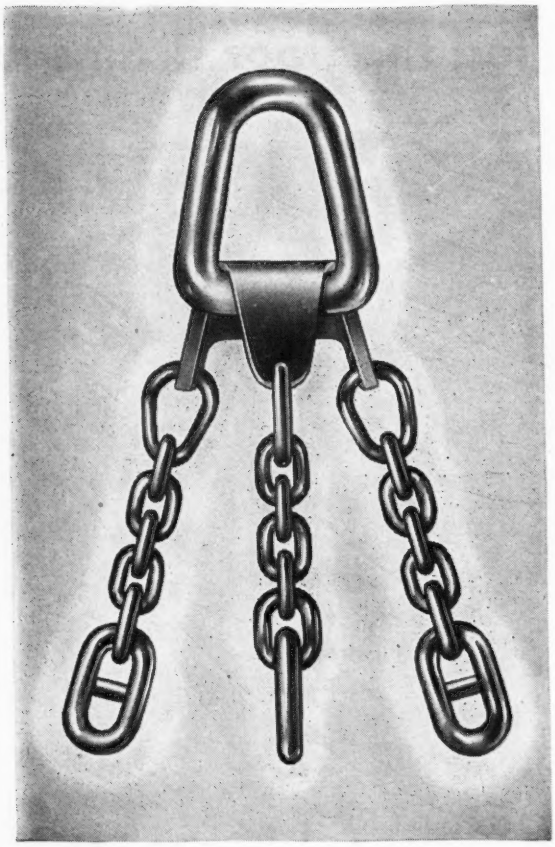


New! **OX BOW MAGNET CHAIN**

Specially designed to take the punishment of handling materials with electro-magnets, this new chain has the following advantages: (1) Cast Steel Yoke supports chain at proper angle, avoids twisting; (2) Large bearing surface between large link and ox bow casting reduces bearing pressure and wear; (3) Short chain links and small clearance between couplings and castings tend to reduce peening and battering of connections; (4) Alloy heat treated chain is hardened to reduce wear.

● *Made to any dimensional specifications in three-leg design, for capacities up to 30 tons.*

ACCO York, Pa., Boston, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, Portland, San Francisco, Bridgeport, Conn.

AMERICAN CHAIN DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

In Business for Your Safety

NEWS SECTION

A.S.A.E. Meetings

THE NORTH Atlantic Section of the American Society of Agricultural Engineers, according to announcement received from its chairman, A. W. Clyde, Pennsylvania State College, will hold its usual yearly meeting at the Hotel Roosevelt in New York City on November 12 and 13. The program for the meeting is now in the process of preparation and will shortly be announced.

The Society's Fall meeting, scheduled to be held at the Stevens Hotel, Chicago, December 17, 18, and 19, has been cancelled for this year. While the government ban on meetings has been eased to the extent of permitting meetings in which out-of-town attendance does not exceed 150 persons, from the previous limit of 50 persons, this was not sufficient to make it possible to hold the meeting since at the last Fall Meeting held in 1943 the total registered attendance was in excess of 500 persons, and it is expected that a much larger number would have attended if the meeting were held this year as planned.

In lieu of the Fall Meeting, however, arrangements are being made by the Society's Meeting Committee for holding of such smaller meetings or conferences as may seem desirable to meet the needs of comparatively small groups that desire to meet in order to give attention to matters of a more or less urgent character. The Meetings Committee has invited members of the Society to suggest such meetings as should be held.

The next meeting of the Chicago Section of the Society will be held on Monday, October 1, the program of which will be devoted exclusively to the subject of engineering farm structures. Details of the program, including speakers, will be available shortly.

As previously announced, the Society's next Annual Meeting will be held at the New Jefferson Hotel in Saint Louis, June 24, 25, and 26, 1946.

Washington Section Meets September 14

LAUNCHING its 1945-46 meeting season, the Washington Section of the American Society of Agricultural Engineers will hold its first meeting on September 14 at 11:50 a. m., in Room 6962, South Agricultural Building, USDA. Dr. M. L. Nichols, chief of research, Soil Conservation Service, will act as chairman of the meeting. The speaker for the occasion will be Dr. Walter C. Lowdermilk, an assistant chief of SCS, who recently returned from a trip to China; he will tell his impressions of Chinese agriculture.

Persons other than A.S.A.E. members who may be interested in the program are cordially invited to attend the meeting. It will be a luncheon meeting and the price of the luncheon is 50 cents. Advance reservations are desirable, and should be made with J. W. Simons, secretary-treasurer, Washington Section, who is located at the USDA Research Center, Beltsville, Md., and whose telephone number is WA 4200, extension 118.

A total of ten monthly meetings are being planned for the Section, most of which will be held on the second Friday of each month.

Walker New A-E Head

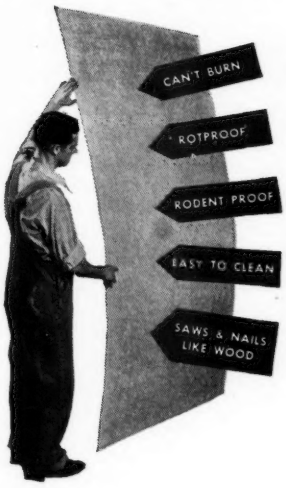
OREGON State College at Corvallis announces the appointment, effective July first, of Clyde Walker as new head of the agricultural engineering department of that institution.

Mr. Walker, a graduate of the University of Nebraska, where he majored in farm mechanics and took some graduate work in vocational-agriculture education, joined the agricultural engineering teaching staff at Oregon State College in 1928. In later years and until his recent appointment, he has been serving as extension agricultural engineer for the state.

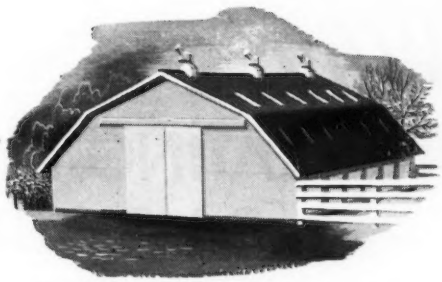
West Virginia Has New A-E Department

WEST VIRGINIA University at Morgantown has established a new and separate department of agricultural engineering as of July first, according to word received from Alfred D. Longhouse who has been appointed head of the new department. Until his appointment Professor Longhouse was serving the institution in the capacity of assistant professor of agricultural mechanics in the department of rural organization; at present he is on leave to complete the requirements for a Ph. D. degree at Cornell University, in connection with which his work will be largely in agricultural engineering.

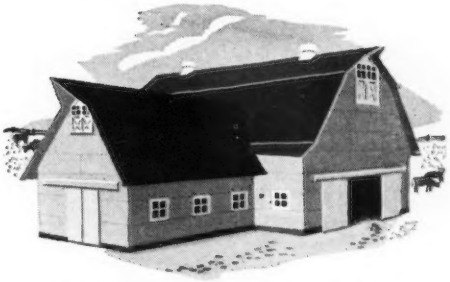
for permanence, economy, fire safety-



specify Johns-Manville Asbestos Flexboard



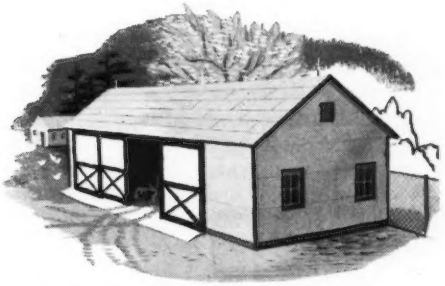
Hog Houses—Flexboard on the exterior walls makes a low-cost, weather-tight building.



Dairy Barns—Inside or out, Flexboard saves money because it needs no painting or whitewash and is easy to keep sanitary.

Quick facts about Flexboard—Made of asbestos and cement, Flexboard is hydraulically pressed and then repressed for extra strength. It has the permanence of stone, yet is inexpensive and easy to work. Comes in large 4′ x 8′ sheets. Has a hard smooth surface that's easy to clean, needs no paint or whitewash. Flexboard is fireproof, rotproof, moisture-proof, rodent-proof. Can be used inside or out for walls, roofs, floors or ceilings on new or remodeled structures.

A free research service—Johns-Manville maintains one of the most complete research laboratories in the world on Building Materials. If you have a special farm building or research problem, write to the farm division about it. J-M will gladly work with you to the extent of its facilities.



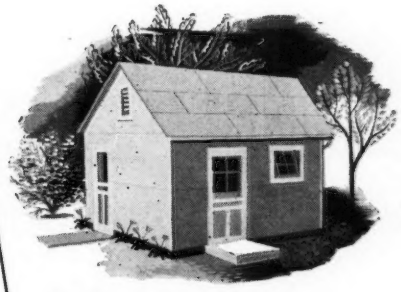
Machine Sheds—Flexboard walls and roof provide quick, low cost, yet permanent construction.

Are your files up-to-date?

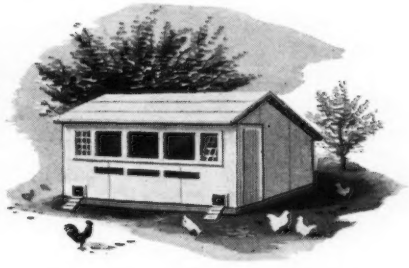
Have you got the following Johns-Manville printed material?

1. Farm Idea Book
2. Agricultural Handbook
3. Maintenance & Repair Manual
4. Farm Building Plan Service
5. Low-Cost Farm Structures

Indicate the material you want and write to Johns-Manville, Department AE, 22 E. 40th St, New York 16, New York.



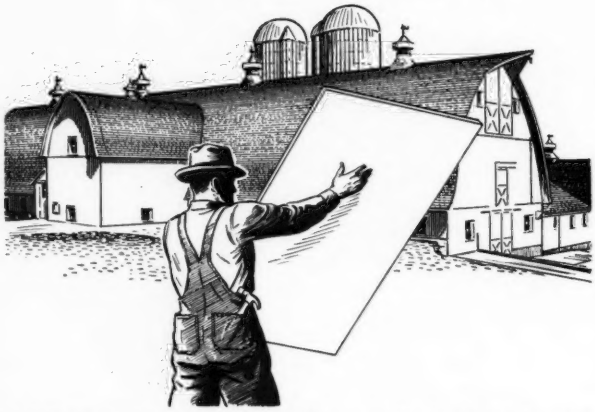
Milk Houses—Flexboard is easy to wash down. Helps meet the most rigid health regulations.



Laying Houses—Flexboard helps fight poultry diseases because it's easy to clean, easy to disinfect.

Johns-Manville **Asbestos Flexboard**

Why INSULATING BOARD *in* DAIRY BARNS LIKE THIS?

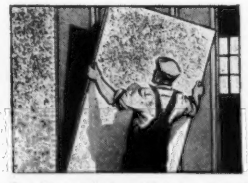


1. When you build with Insulite, you do *two big jobs* with one material—you build a strong, enduring structure, and *you insulate at the same time!*

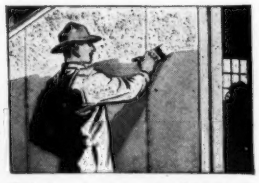
2. Insulite, a time-tested structural insulating board, takes the place of ordinary sheathing. The big four feet wide boards cover a large area in one application, saving in time.

3. Used on interior walls and ceilings, Insulite provides a second wall of insulation, and an interior that can easily be painted, kept clean and sanitary. Insulite is easy to handle, easy to saw, easy to nail.

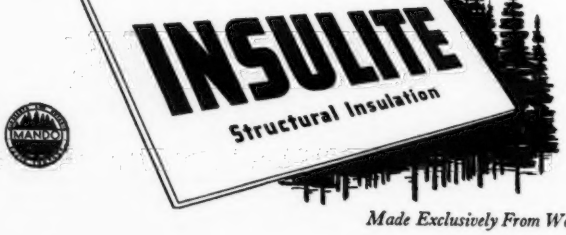
For further information, address INSULITE, Dept. AE 95, Minneapolis 2, Minnesota.



Insulite applied to the inner side of the framework completes the wall and ceiling construction, materially aiding the functioning of the ventilating system.



Nailed to the outer side of the framework on old or new buildings, Insulite requires only paint as protection for many years of service against the elements.



Made Exclusively From Wood

Personals of A.S.A.E. Members

Commander Quincy C. Ayres, who has been serving in the Bureau of Yards and Docks, U. S. Naval Reserve, during the war period, has now returned to civilian status, and has been appointed assistant to the president of Iowa State College. In addition to his new duties he will retain his previous connection with the institution as professor of agricultural engineering.

Nils Berglund, the only A.S.A.E. member in Sweden, who has been on the membership roll since 1923, but who has been out of contact with the Society for over three years on account of the war, is now able to renew that contact, and for the benefit of his friends in the United States writes that he is still engaged in teaching and research work on farm machinery at the Agricultural College of Sweden at Uppsala.

Kyle Engler, head, department of agricultural engineering, University of Arkansas, is one of the authors of Bulletin No. 457 of the Arkansas Agricultural Experiment Station, entitled "Ground Water supplies for Rice Irrigation in the Grand Prairie Region, Arkansas," based on studies made by the Arkansas station in cooperation with the Arkansas Geological Survey and the U. S. Geological Survey.

George H. Foster has resigned as assistant in agricultural engineering at the Indiana Agricultural Experiment Station where he has been employed in special investigations work on the relation of electricity to agriculture, to join the agricultural engineering staff at the State College of Washington at Pullman, where he will be engaged in rural electrification research work. The new position which he is filling was created through a research grant made by the Booneville Power Administration.

Dan M. Guy has been appointed manager of the agricultural division, technical service department, Ethyl Corporation. His headquarters will be at the engineering research laboratories of the corporation at Detroit. He joined the Ethyl Corporation in 1931 and has specialized in agricultural engineering for the past ten years.

George C. Marti, a native of Mexico and an engineering graduate of the University of California majoring in agricultural engineering, is now back in Mexico to put into practice the experience and knowledge gained from university studies in this country as well as from two years of on-the-job training in the manufacture of agricultural machinery as a trainee under the supervision of the International Training Administration, Inc., On completion of this training he prepared an extensive report of the two years' work and was given a certificate of award which was presented to him in Washington by the Coordinator of Inter-American Affairs.

Ray I. Shawl, professor of farm machinery, University of Illinois, is listed as author of Circular 591 recently issued by the Illinois Agricultural Extension Service, and entitled "Homemade Power Cutters for Weeds and Grass."

J. W. Simons recently resigned as construction engineer, Office of Materials and Facilities, War Food Administration, to return, following wartime service in the WFA, to the Divisions of Agricultural Engineering, Bureau of Plant Industry, Soils and Agricultural Engineering, USDA, where he will be head of the plan exchange and information section and the rural housing section in the Division of Farm Buildings and Rural Housing.

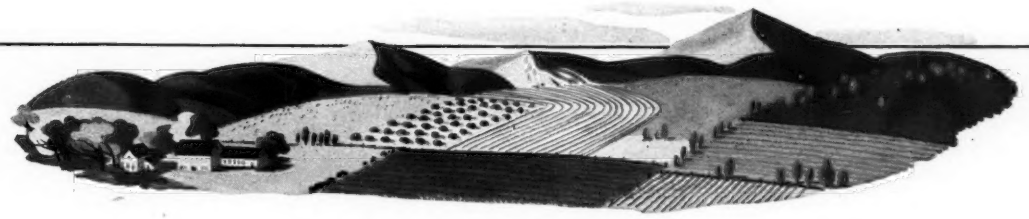
Invention Goes Underground

(Continued from page 355)

For the sake of national progress, as well as justice to the independent inventor, we do indeed need patent reform. Possibly patent protection should be made weaker for the strong. Certainly it should be made stronger for the weak. It is not enough to reduce the cost and red tape of securing a patent. Some way should be found to prevent stealing of patents without spending a fortune in litigation.

Among the lesser causes mentioned in the Little analysis is the absence in the armed forces of many men in the more prolific age for invention, and others who normally would be in technical training. It remarks that while we well-nigh depopulated our technical schools, Britain and Russia kept theirs nearly at normal. At least we should try to atone for this deficiency by aggressive promotion of higher education for promising men released from service.

THE FUTURE AND 80 ACRES



Bivouacked on far-flung battlefields tonight, thousands of American boys will pillow their heads on foreign soil and dream . . . of peace, and 80 acres!

Weary of war and adventure, the simple but sound ambition of these future American leaders is a piece of land they can call their own, with the peace of mind that is a farmer's birthright.

John Deere is happy that the farms to which these boys will return, or the new lands they will break, will afford even a pleasanter and more profitable way of life than that their fathers knew.

This will be true, in no small measure, because of the labor-saving and time-saving farm implements that will come from John Deere plants as the soldiers come from the battlefields.

They will be implements that have been brought ever nearer to perfection through 108 years of patient research and persistent tests by the organization that gave to the world the steel plow.

They will be implements sold and serviced through a nation-wide group of John Deere dealers whose lives are dedicated to serving those who serve mankind so well.

So, welcome to the land . . . soldier! Peace and prosperity to you in the fruitful days ahead!

JOHN DEERE QUALITY FARM EQUIPMENT

JOHN DEERE **QUALITY FARM EQUIPMENT SINCE 1837**

MOLINE, ILLINOIS

Necrology

WILLIAM DAVIS COLLINS, inventor and intensive user of power farming equipment in England, passed on recently at his home, Chancery House, Tenterden, Kent.

Mr. Collins, a graduate of Ardingley College in Sussex in mechanical engineering and land surveying, achieved considerable distinction in England for his work in the mechanization of agriculture. From 1895 to 1931 he was engaged in power farming, and in 1916 joined the staff of Caterpillar Tractors (England), Ltd., where he had charge of all of the firm's tractors and agricultural equipment.

Mr. Collins was the first to use track-type tractors for agricultural work in England, his farm being the first fully tractor-equipped farm in that country. During World War I his tractors furnished power for over 6000 acres of land. In addition to his other accomplishments, Mr. Collins was the inventor of the Collins-Feeny Vaporizer for kerosene which kept his tractors working during wartime when all the gasoline available was required for military purposes.

Mr. Collins is survived by his wife.

* * * *

FRANK A. DONALDSON, president, Donaldson Company, Inc., manufacturers of air cleaners for internal-combustion engines and crankcase ventilating systems, passed away August 26th at his home in Minneapolis.

Mr. Donaldson was born at Rochester, Minnesota, on December 29, 1889, and was graduated from the University of Minnesota in 1912 with the degree of bachelor of science in engineering.

Following his graduation he entered the engineering department of the Emerson-Birmingham Company and was later connected with the Bull Tractor Company. He invented the first air cleaner ever applied to farm tractors while he was a field engineer for the latter company. In 1915 he began the manufacture of this device in his own company which was incorporated in 1918. Since that time he has served as president and general manager of the business.

During World War I Mr. Donaldson had charge of the engineering work on artillery tractors. He served as a captain in the U. S. Army's ordnance department where he was directly connected with the motor equipment section of the engineering division.

Mr. Donaldson is survived by Mrs. Donaldson and two sons and two daughters.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

William T. Chadwick, S/Sgt, AAF, Weather Wing. (Mail) 1008 22nd Ave., Monroe, Wis.

David L. Firor, Lt., USA, Hq. Co. 2nd Bn., 27th Inf. (Mail) APO 25, c/o Postmaster, San Francisco, Calif.

Welker W. Funk, chief engineer, King Farms Co., Morrisville, Pa.

William W. Merson, designer, harvester division, Cockshutt Plow Co., Ltd., Brantford, Ont., Canada. (Mail) 192 Brant Ave.

K. L. Pettit, professor, Rykslandbouwhoogeschool, Coupure Links 213, Gent, Belgium.

W. D. Potter, hydraulic engineer, Soil Conservation Service, USDA, Washington, D. C.

Reuben H. Retz, mechanical engineer, power plant laboratory, Air Technical Service Command, Wright Field, Dayton, Ohio. (Mail) 2025 Howell Ave.

Barton C. Reynolds, agricultural engineer, Office of Experiment stations, USDA, Washington, D. C.

Everett W. Todd, manager, tillage engineering department, The Massey-Harris Co., Racine, Wis.

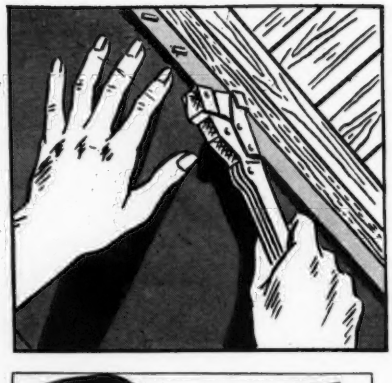
TRANSFER OF GRADE

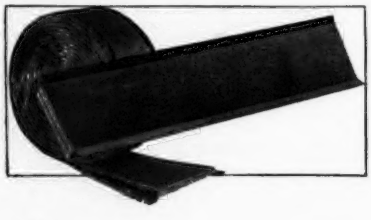
D. S. Horne, project engineer, Cockshutt Plow Co., Ltd., Brantford, Ontario, Canada. (Mail) 41 Sheridan St. (Junior Member to Member.)

Homer D. Witzel, design engineer, also project and development engineer, The Oliver Corp., Battle Creek, Mich. (Mail) 115 So. 24th St. (Junior Member to Member.)

For Dependable Insulation

RECOMMEND MASONITE CELL-U-BLANKET!





Good insulation pays! In the farm home it brings lowered fuel costs, more summer comfort; in farm structures it helps lower animal mortality, increases the return on the farmer's investment.

The advantages of Masonite* Cell-U-Blanket insulation are manifold. It's easily and permanently applied by the farmer or his help. It stays in place without settling or shrinking. It's light in weight. It's water- and windproofed and is treated to resist mould, rot, flame and termites.

This efficient insulation comes in rolls or panels of varying widths and thicknesses. For complete information, write Masonite Corporation, Dept. AE-9, 111 W. Washington Street, Chicago 2, Illinois.

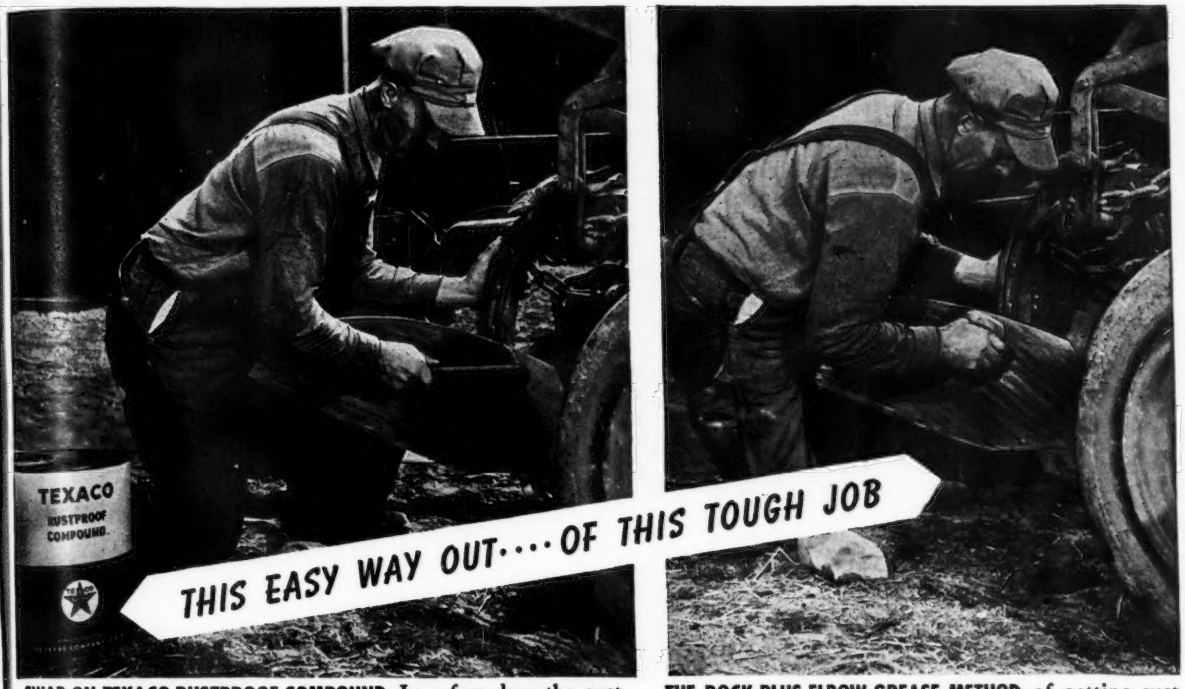
MASONITE

CELL-U-BLANKET INSULATION

REG. U. S. PAT. OFF.

*"Masonite" is a trade-mark registered in the U. S. Pat. Off. and signifies that Masonite Corporation is the source of the product.

How Farmers can save "Elbow Grease" when they've got a Rust Problem



SWAB ON TEXACO RUSTPROOF COMPOUND. In a few days the rust is loosened — comes off easily. A second coat keeps it off.

THE ROCK-PLUS-ELBOW-GREASE METHOD of getting rust off plow shares is costly in time, labor and money.

IT is worth while to know that the product which has been proved in extensive tests by Agricultural Engineers to effectively *prevent rust*, also contains special ingredients that *loosen rust*—easing the job of removing rust.

A farmer can (and often does) forget to protect his machinery until it's rusty. That's when Texaco Rustproof Compound can save him "elbow grease" in the job of scrubbing off the rust.

Texaco Rustproof Compound penetrates existing rust, loosens it and stops further rusting.

Of course, it should be put on machinery before rust forms, and when it is, the farmer is saved all troubles due to rust. One application gives complete season-to-season protection.

That's why it pays to have a supply of Texaco Rustproof Compound on hand. It is inexpensive and economical to use.

THE TEXAS COMPANY

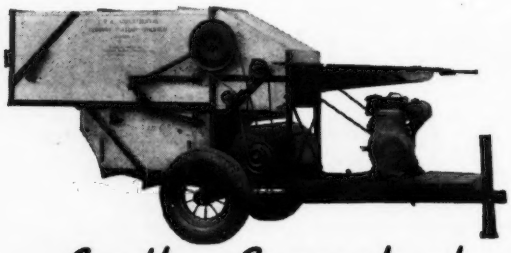
IT BEATS THE WEATHER

Texaco Rustproof Compound prevents rust formation. It penetrates rust and stops further rusting. It loosens rust so that it's removed easily. (A second coating keeps rust off.) It saves time, labor, money and metal.

Available in 5 and 25 pound cans and 100 pound drums

IT PAYS TO FARM WITH TEXACO PRODUCTS

DIVISION OFFICES: Atlanta 1, Ga.; Boston 17, Mass.; Buffalo 3, N. Y.; Butte, Mont.; Chicago 4, Ill.; Dallas 2, Tex.; Denver 1, Colo.; Houston 1, Tex.; Indianapolis 1, Ind.; Los Angeles 15, Calif.; Minneapolis 2, Minn.; New Orleans 6, La.; New York 17, N. Y.; Norfolk 1, Va.; Seattle 11, Wash.



Another Example of

WISCONSIN-POWERED FARM EQUIPMENT

The Turner two-wheel Economy Trailer Thresher illustrated above (made by the Turner Mfg. Co., of Statesville, N. C.), illustrates another interesting Wisconsin Air-Cooled Engine application. Powered by a single cylinder Model AHH Engine (7-9 hp.), this separator will handle 25 to 50 bus. of wheat per hour, 50 to 90 bus. of oats, and comparable capacities in other grains. This thresher can be hitched behind a passenger car or truck and quickly towed to the job . . . and the air-cooled Wisconsin Engine is always ready to go, in any weather.

Today Wisconsin Air-Cooled Engines are supplying more than 3,000,000 hp. in the service of agriculture!

Most H.P. per pound

WISCONSIN MOTOR Corporation

MILWAUKEE 14, WISCONSIN, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

Farming on the Contour with

REGULAR EQUIPMENT

Regular farm equipment does an excellent job of contour farming. Because it has the advantage of highly automatic control, modern farm equipment is ideally suited for soil conserving operations. The soil is everyone's concern. That's why the farm equipment industry is leading the way in the vital campaign for soil conservation—a campaign to safeguard our future.

INTERNATIONAL HARVESTER COMPANY

180 North Michigan Avenue **Chicago 1, Illinois**

EMPLOYMENT BULLETIN

(Continued from page 388)

ASSISTANT AGRICULTURAL ENGINEER wanted for research in hydraulics, irrigation, soil and water conservation. Equal division between college of agriculture and the agricultural experiment station, including cooperative projects with Soil Conservation Service. Salary depends upon qualifications and experience. Give full particulars including military status with applications. University of Idaho. PO-180.

DRAFTSMAN wanted for development and design work on tractor and garden ground-working tools. Good opportunity for a man who can apply himself in this branch of agricultural tool development and designing. Location, Chicago, Illinois. PO-179.

ASSISTANT EXTENSION AGRICULTURAL ENGINEER wanted by Arkansas Agricultural Extension Service. The phases of work to be handled and the salary will depend primarily upon the training and experience of the applicant. Give brief explanation of training and experience in first letter. Write direct to L. A. Dhonau, State Agent, 524 Post Office Building, Little Rock, Arkansas.

AGRICULTURAL ENGINEERS, preferably men with some experience in farm equipment, are wanted by a nationally known manufacturer. Experience desired includes design, engineering applications, market research and merchandising. Excellent opportunity for men possessing either limited or broad experience. Salary open. Replies received on a confidential basis. Education, experience and special qualifications should be stated fairly complete in the first letter. PO-178

ENGINEERS AND DRAFTSMEN wanted by well-known manufacturer of farm and garden implements, to develop and design new tools, garden tractors and equipment. Positions permanent. PO - 177.

AGRICULTURAL ENGINEER wanted by large steel manufacturer entering farm building field. Excellent opportunity to join growing organization with promising postwar future. Salary open. Principal qualification is knowledge of and experience in design and construction of farm buildings; also knowledge of raising poultry, dairy cattle and swine. Replies, which will be held confidential, should state education, references and experience, and include small photograph. PO-176.

DISTRICT MANAGER wanted for western New York. Experience in the sale of dairy farm equipment helpful, but not essential. Must have automobile. Postwar future. Salary, expense allowance and commission. Thorough field training, during which salary and expenses are paid. Write in detail, stating age, education, experience, and at least three character references. PO-175.

AGRICULTURAL ENGINEER wanted by the Allahabad Agricultural Institute, Allahabad, India, for teaching position. Minimum qualifications, degree in agricultural engineering and some farm experience. Postgraduate degree desirable. Duties would be primarily teaching, but some opportunity to participate in research and extension. Candidate must be active Christian interested in mission work. Discharged veteran with slight handicap eligible, if in good health otherwise. Applicants may correspond with Allahabad Agricultural Institute, 156 Fifth Ave., New York 10, N. Y.

RESEARCH ENGINEER wanted for work in farm structures and electrification in a land-grant college in a north central state. A young man is preferred. Salary $3,000 or more depending upon qualifications. Write giving full details of education, experience, draft status, and other particulars. PO-174.

SALES ENGINEER wanted for permanent position with small company producing well-accepted building material products. Substantial base salary, better than average proposition for man with liking for sales work and knowledge of building construction. Give full information on past experience and earnings expected. PO - 166.

ENGINEERS wanted. Allis-Chalmers Mfg. Co., LaPorte, Ind., can use several designers, draftsmen, and detailers on agricultural harvesting machinery. Address all communications giving full particulars to Chief Engineer, Harvester Engineering Dept.

ASSISTANT AGRICULTURAL ENGINEER wanted for permanent position in Conservation Division, Indian Service, U. S. Dept. of Interior. Duties include farm conservation and flood control structures design. If not experienced in agricultural engineering, applicant should indicate civil engineering background or experience. Civil service status necessary. Applicants may correspond direct with T. B. Hall, Superintendent, Osage Indian Agency, Pawhuska, Oklahoma.

POSITIONS WANTED

ENGINEER with bachelor's degree in mechanical engineering; additional courses in refrigeration, heating, ventilating, and air conditioning; experience in soil conservation, tool design, construction, and maintenance; farm background consisting of dairying and general farming, has been released from war work and desires employment in the agricultural-engineering field. Prefers location in north central states with work dealing directly with farm problems. PW-374.

AGRICULTURAL EQUIPMENT BLOCKMAN available. Agricultural engineering graduate Kansas State College; 13 years' sales, collection and service experience with large farm machinery manufacturer; two years' teaching farm tractors at war training school; 1½ years' as industrial specialist in farm machinery division of WPB in Washington, and 2 years' war factory production. Desires high-type sales position in Southwest. Age 41, excellent health, married, rural background, superior salesman-executive, good organizer and consistent producer. Best references. PW-373.

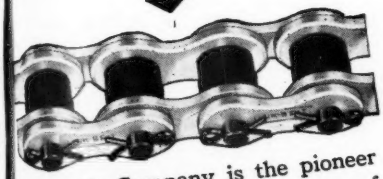
AGRICULTURAL ENGINEER desires employment with either farm machinery or farm buildings construction company; is principally interested in functional design of farm machinery or buildings. Graduate in agricultural engineering from Iowa State College in 1933. Has had 12 years' experience in agricultural engineering work including soil conservation, land surveys, and farm building construction. Is presently managing a large number of farms in Minnesota where tenants are part owners of livestock. Prefers north central states. Age, 35. Married, 3 children. Can give excellent references and employment record. PW-372.

(Continued on page 392)

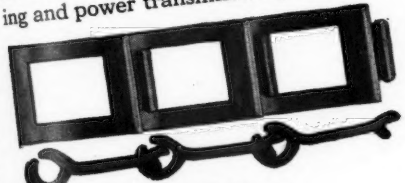
A Minneapolis-Moline Universal "R" tractor pulling a power-takeoff driven M. M. Harvester "69" with recleaning attachment harvesting soybeans. Link-Belt Chain used.

MODERN MACHINERY *Helps America's Farmers Fill World's Bread Basket*

MODERN LINK-BELT CHAINS
Supply Efficient Drives



Link-Belt Company is the pioneer and world's largest manufacturer of all types of chains in malleable, Promal, and steel, for every conveying and power transmission purpose.



Farms of America have become part of the "Arsenal of Democracy." The unimagined demand for production is being met, but only by calling on every resource of energy and ingenuity. And implement builders have made major contribution to this achievement, by developing new, skillfully engineered, precision-built machinery, capable of many times the production of their predecessors of only a few seasons ago. Important drives and conveyors on representative farm implements of today employ efficient, modern Link-Belt Chains, which have been improved and will continue to be improved in keeping with advances made in all types of machinery.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Offices in Principal Cities. 10,002

LINK-BELT CHAINS

FOR DRIVES • FOR CONVEYORS • FOR POWER TRANSMISSION

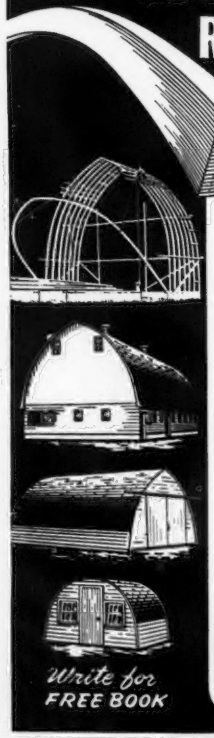
For

Covering Hay Stacks
Sealing Grain Bins
Protecting Machinery
Making Temporary Silos

Every dollar's worth of Sisalkraft gives more value in terms of protection from rain and moisture than any other method or material. Low in cost . . . easy to handle . . . resists tears and punctures. Field-proved on the farm for more than 13 years.

THE SISALKRAFT CO.
205 W. WACKER DRIVE, CHICAGO 6, ILL.
Manufacturers of SISALKRAFT, FIBREEN, SISAL-E, SISALTAPE AND COPPER-ARMORED SISALKRAFT

RILCO *Laminated Wood* **RAFTER ARCHES**



READY TO ERECT . . . . NO MEASURING, CUTTING OR FITTING . . . .

Rilco Rafters are delivered to the farm ready for erection, accurate as to dimension, end trimmed and drilled. They can be erected in less time than any other type of framing. The erection is accurate, because all measuring, cutting and fitting has been done at the factory.

This is a tremendous value to farmers. It assures sound construction. As the foundation is being poured, sill anchor bolts are placed 6 feet on centers. Holes for these bolts are a simple matter to drill in the sill. So also are the holes for the Rilco angle irons which anchor the rafters to the sill.

Simple, clear directions for erecting the rafters accompany each shipment. These directions cover two types of framing — horizontal drop siding—vertical car siding.

After sill is in place, the rafters are joined at the ridge with metal ridge plates, then raised as a single arch and bolted to angle irons at sills. Rilco Rafters not only assure better construction but save time and labor in erection. The side wall and roof framing of a Rilco 34x60 barn has been erected by five men in 5 or 6 hours.

The Rilco Catalog illustrating rafters for every type of farm building together with engineering data will be sent on request.

Write for FREE BOOK

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A Weyerhaeuser Institution
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EMPLOYMENT BULLETIN

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RESEARCH ENGINEER available. Research course work begun in December, 1943, at Iowa State College towards a Ph. D. degree. Other academic and professional education was at State College of Washington, 1933, B. S.; 1934, M. S.; 1939, Ag. E. Also a registered professional engineer. Seventeen years of education and experience since entering college in September, 1928 (self-liquidating). Experience in the federal government, land-grant institutions, and private power systems. Born and reared on a farm. Temporarily employed as an assistant extension agricultural engineer. Thirty-five years of age, married, two children. Available at salary range of $4,000 to $8,000 per year. PW-365.

"Improved Farm Implements"

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to constitute a full set of implements. Forty years ago a farmer could carry all the tools required on a farm of ordinary size, in an ox-cart, at one load; but today, the tools and machinery on that same farm cannot be transported in six ox-carts. Let us, for a moment, direct our attention to the implements for gathering a crop of grain, and preparing it for market. Then, a cradle worth $2.50, and a rake worth twenty-five cents, a flail fifty cents, and a fan for cleansing the grain worth $1, was about all that was required; but today, the mower, the reaper, and the threshing machine must be brought into requisition. Almost every operation must be performed by efficient and complex machinery, requiring years of practical experience to manage with skill and efficiency. Almost every operation is performed on the farm by some kind of implement, which requires more wisdom, judgment, and discretion to put it in order and to keep it from getting out of order, than an engineer exercises in running a steam engine.

"We are a nation of scientific inventors. Every week or every month developments in labor-saving machinery are given to the world, that astonish everybody. The man who launches forth in some new enterprise, flattering himself that the world will stand aghast before his profound wisdom, is almost overwhelmed with chagrin at the thought that some live Yankee is close at his heels with an invention which will eclipse the brightest feature in his machine. As men become familiar with the laws of matter, and acquaint themselves with philosophical and mechanical principles, they discover how easy it is to make an application of their knowledge in improving some of the implements of agriculture."

I am not sufficiently versed in the history of our organization to know when the term "agricultural engineer" was first used but certainly this must be one of the older references to the term and the development of farm equipment by such individuals.

C. A. LOGAN.
Superintendent, Office of Operations, USDA (Beltsville, Md.) Research Center.